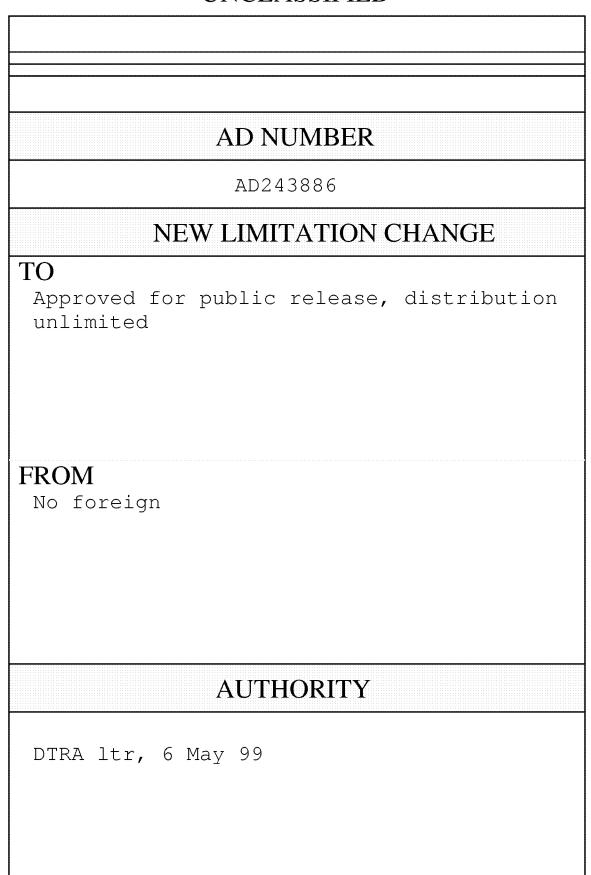
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Rocketsonde and Satellite Messurements of Pressure, Temperature, Density, and Composition through Early 1960

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Project ARIES
Contract Nonr 3071(90)
1 August 1960

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Science Communication, inc.

1079 Wisconsin Avenue, N.W. WASHINGTON, D. C.



PROPERTIES OF THE UPPER ATMOSPHERE

Rocketsonde and Satellite Measurements of Pressure, Temperature, Density, and Composition Through Early 1960

PROJECT ARIES
Contract Monr 3071(00)
1 August 1960

SCIENCE COMMUNICATION, Inc. 1079 Wisconsin Ayenue, N W. Washington 7, D. C.

PROPERTIES OF THE UPPER ATMOSPHERE

Rocketsonde and Satellite Measurements of Pressure, Temperature, Density, and Composition Through Early 1960

INFORMATION SOURCES AND TREATMENT

The data given in this compilation were obtained from reports, publications, and direct communication with scientists who have made upper atmosphere structure measurements with sounding rockets and satellites. Data are reported for the 30 to 300 kilometer altitude range. It is estimated that over 90 per cent of the data available through the Spring of 1960 are presented in this cabulation. Only data considered "publishable" by the authors (i.e., technically suitable for general use) are included.

An effort hes been made to provide an accurate compilation and to present information about the experimental circumstances associated with the measurement. Should the reader encounter technical errors, corrections will be gratefully received and an errata sheet issued.

The compilers have not "evaluated" data obtained.

Those who wish to make critical discrimination among the tabular entries are urged to review the appropriate abstract-references and instrumentation discussions cited in this report.

The data are presented in two tables. The first presents temperature, pressure, and density. The second presents composition measurements. Both are arranged by altitude.

Abstract-bibliographies of key source documents are presented in Appendix B. An abstract-bibliography of general review publication on the upper atmosphere is provided in Appendix C.

The functional principles, an illustrative description, and key references for the instruments employed in the measurements reported are described in Appendix A. The instrument discussions place particular emphasis on sources of error.

Contract Nonr 3071(00) Final Report 1 August 1960 -2-

Properties of the Upper Atmosphere

NOTATIONS IN TABLES

Errors

The "e" columns immediately to the right of the Pressure, Temperature, and Density columns are the probable errors of the measurement, as obtained from the author. The notation (nf) (in this section and elsewhere) indicates that the information was "not found".

Flight Number

Most of the entries in the "Number" column are IGY rocket flight code numbers. The system is described in the conversion aids at the end of this introductory section. Various designations were used for rocket flights made before the IGY program, and are included whenever they were available.

Time

Flight times are given in local time (to communicate durnal significance), following the practice in research reports and papers. A time-zone conversion table is given in the conversion aids section.

<u>Altitude</u>

Altitude is given in kilometers. Altitude measurements at all launch sites were made by the DOVAP system, which has an estimated accuracy of gl meter. An altitude conversion table (kilometers - miles - feet) is given in the conversion aids section.

Temperature

Temperature is presented in degrees Kelvin. A temperature conversion table $({}^{\circ}K - {}^{\circ}C - {}^{\circ}F)$ is given in the conversions aids sections that follows.

Washington, D. C.

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1 August 1960

IGY Rocket Numbering Code

Flight Number: Place 1. Directing Agency Place 2. Instrumenting Agency Place 3. Type of Vehicle Place 4. Directing Agency's Serial Number Place 5. Purchaser of Vehicle, if not Directing Agency

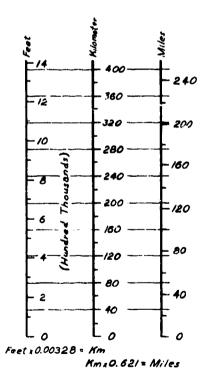
Symbols used in Places 1, 2, and 5

- A. Air Force Cambridge Research Center
- B. Ballistic Research Laboratories
- F. National Science Foundation
- M. University of Michigan
- N. Naval Research Laboratory
- S. Army Signal Corps

500° 480* - 2200 480 200 440° 460° 400 1800 440 160 360° 420 -320° /40 400 -2**8**0° -120 380 240 100 360° =2*0*0° - 80° 340° = 160° 60 3200 =/20* 40 300 = 80° - 200 280 40 O° 260° 00 K°- 273° = C° [\$ C*]+32* F*

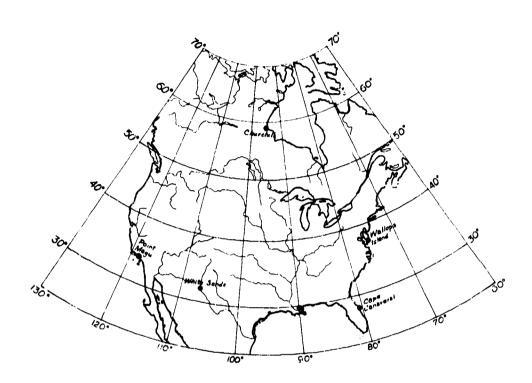
Symbols used in Place 3

- 1. & 2. Aerobee
- 3. & 4. Aerobee-Hi
- 5. Balloon-rocket (Rockoun)
- 6. Nika-Cajun
- 7. Nike-Deacon (DAN)
- 8. Nike-Asp
- 9. Loki Il -Dart
- 10. Spaerobee
- 12. Aerobee 75



Height Conversion Table

Washington, D. C. Project ARIES - Contract Norm 3071(00) Final Report 1 August 1960



PLACE	20 ₁	i			7.1	Œ				
Greenwich	GMT	0000	0300	0600	0900	1200	1500	1800 	2100	2400
Wallope Island	est	1800	5100	2400	0300	0600	0900	1200	1500	1800
Fort Churchill	CST	1700	2000	2300	0200	0500	0800	1100	1400	1700
White Sanda	Ket	1600	1900	2200	0100	or ∞	0701	1000	1300	1600
Point Mugu	PST	1500	1800	2100	2400	0300	0600	0900	1200	1500

TIMA: CONVERSION TABLE

UPPER ATMOSPHERE STRUCT Measurements Reported Throng

									waheridd I	wiond
_	Allitude	Proc	sure	Den		Temp	prature			
· B -	Err.	mmi	ig. 0.%	g/m²	•,%	4	•. 'K	Instrumentation	Vehicle	Number
								ALTI	TUDE RANGE 30-40	Km.
1	30	3.0	(v)	•	•	•	•	Pirani gage*	V- 2	28
	30	1.2	(nt)	•	•	-	•	Alphatron*	Aerobee	(nf)
I	30	-	•	-	-	234.6	3.0	Grenade	Aerobee	8C-1 8
•	30	1.2	(mf)	•	•	230	5.0	Alphatron*	Asrobee	(nf)
I	30	•	-	•	•	226	8.0	Alphatron*	Aerobee	(nf)
I	30	•	•	1.8	2	•	•	Sphere*	Aerobee	80-31
_	30	•	•	1.8	(p)	•	•	Ionisation gage	Aerobee	ANR .21
I	30	-	•	1.8	2	213	4.2	Sphere*	Nike-Cajun	AM6.10
	3 0	•	•	1.4	2	213	4.2	Sphere*	Ni ke-Cajun	AM6.12
ı	30	4.3	(nf)	10.3	(nf)	550	2.0	Granade	Aerobee	890.01
ı	30	8.0	(mf)	17	(nf)	237	2.0	Orenade	Aerobee	810.03
•	30		(nf)	21	(nf)	236	2.0	Grenade	Aerobee	810.04
1	30	6.8	(nf)	14	(nf)	236	2.0	Grenade	Aerobee	ama.05
	30	7.0	(nf)	17	(nf)	201	2.0	Grenade	Aerobee	200 .07
	30	•	•	•	•	208	2.0	Granade	Aerobee	80.08
ı	30	•	-	1.8	2	200	4.0	Sphere*	Nike+Cajun	WE-05
	30	•	-	1.4	2	213	4.2	Sphere*	Aerobee	802. 10
	30	4.6	(nf)	n	(nf)	204	2.0	Granade	Aerobee	812. 10
•	30	1.9	(nf)	16	(nf)	208	2.0	Grenade	Aerobee	801.09
	30	•	•	1.8	8	210	4.2	Sphere*	Ni ke-Cejun	AM6.03
	30	•	•	1.8	2	225	4.5	Sphere*	Wike-Cajun	AN6.05
4	30	-	•	1.8	2	213	4.2	Sphere*	Hike-Cajun	AN6.09
-		_			_					
-	-	~-	_		_		_			-
	_		7-		_					

^{*} These entries are taken from a published

COPPERE STRUCTURE DATA
is Reported Through Early 1960

Vehicle	Number	Place Fired	Date	Time	Zone	Reference Data	Notes	Altitu Range,
JSE RANGE 30-40	Es.							300
▼- 2	28	WEPC	8 Dec '47	14.42	MIT	Spencer 54	(rf)- not found	
Aerobee	(nf)	WSPC	20 Jun '50	08.58	Mat	Sicinski 54	(p) - Preliminary see referen	
Aerobee	8 C-18	WSPG	8 Jun '51	23.11	MIT	Stroud 56		
Aerobee	(nf)	WEPG	13 8ep '51	04.37	MET	Sicinski 54		
Aerobee	(nf)	WSPC	26 Sep "51	(nf)	-	Spencer 54		250
Aerobee	80-31	WSPG	29 Sep '55	13.50	TOM	Jones 58		
Velopee	AMP .21	Churchi 11	25 Oct 156	02.40	CST	Spencer 58-1		
Nike-Cejun	AM6.10	N.Atlantic	4 Nov 156	12.54	CHE	Jones 59	57°46'# 46°41'W	
Nike-Cajun	AN6.12	W.Atlantic	10 Nov '56	07.17	GMT	Jones 59	65°36'# 58°03'W	
Aerob ec	801.01	Churchill	12 Nov '56	05.48	Cet	Stroud 60 & Ba	ndeen	
Aerobee	800.03	Churchi 11	23 Jul '57	23.30	CST	Stroud 60 & Be	ndeen	200
Merobee	811.04	Church111	12 Aug '57	10.00	CST	Stroud 60 & Ba		
Aerobee	8M1. 05	Churchill	19 Aug '57	20.30	Cat	Stroud 60 & Be		
Aerobee	89GL . 07	Churchi 11	11 Dec '57	22.00	car	Stroud 60 & Be	ndeen	A
Merobee	8M1.08	Churchi 11	14 Dec 157	15.00	CST	Stroud 60		A
Kike-Cajun	W6.05	Churchill	25 Jan '58	15.12	CST	Jones 59		190
lerobee	8M. .10	Churchill	27 Jan '58	12.48	CST	Jones 58		,
Nerobee	212.1 0	Churchill	27 Jan '58	12.49	CST	Stroud 60 & Ba	ndeen	
Aerobee	810. 09	Churchill	27 Jan '58	00.04	CST	Stroud 60 & Ba	ndeen	
Nike-Cajun	AM6.03	Churchill.	29 Jan '58	13.06	COT	Jones 59		
fike-Cajun	AM6.05	Churchi 11	4 Mar 158	13.30	CBT	Jones 59		100
like-Cajun	AM6.09	N.Atlentic	2 Nov 159	12.40	CHE	Jones 59	48°57'# 48°22'W	240
			•		-			
					_	كيبني تقبيد سيبين		

••

UPPER ATMOSPHERE STRUCTU Measurements Reported Through

	Altitude	Pres	ture	Dens	ity	Tempe	rature			
L	Km.	mm.H		g/m³	•.%	•X	e, °K	Instrumentation	Vehicle	Number
F									ALITITUTE RANCE 30-40	15m. (C
I	51	11	(mf)	34	(nf)	239	2.0	Grenade	Aerobee	8JQ.02
_	32.1	•	•	1.8	.22	239	5.0	Sphere*	DAN-6	AM7.02
	33.3	-	-	•	-	231.5	4.5	Grenade	Aerobee	ac-1 6
, ,	35.7	•	•	•	•	229	2.1	Grenade	Aerobee	#C-20
	35	-	-	-	-	260	2.0	Grenade	Aerobee	sc-8
	35	-	•	•	•	235	2.0	Grenade	Aerobee	8C-14
:	35	-	-	•	•	242	2.0	Grenade	Aerobee	se. 06
	35.4	-	-	•	-	260.7	1.4	Granade	Aerobee	sc- 8
	35.9	•	-	-	•	234.9	1.4	Grenade	Aerobee	8C-14
	38. 7	•	•	•	•	253.0	1.4	Grenade	Aerobee	8 C-18
1						-				
I				-			-			
11:	-	-			-		_			



^{*} These entries are taken from a published curve

Project ARIES — Contract Nonr 3071(00)

PHERE	STRUCTU	TRE :	Data
Reported	Through	Earl	y 1960

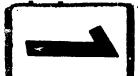
Vehicle	Number	Place Fired	Date .	Time	Zone	Reference Data	Notes	Altitude Range, Km
TR RANGE 30-40	En.	(Concluded)		·				
Aerobee	SM1.02	Churchill	21 Jul '57	22.16	Cat	Stroud 60		
Dan-2	Ak7.02	Walliops	24 Jun '55	13.04	EST	Jones 56		
Aerobee	8 0-16	WEFG	12 Dec 150	02.10	MOT	Stroud 56		<u> </u>
Aerobee	8 0-20	WEPG	1 Nor '51	02.46	MOT	Stroud 56		<u> </u>
Aerobee	ac-8	MERG	14 Jul '50	01.37	MBT	Weisner 54		200
Aerobee	SC-14	Wapc	11 Dec '50	21.06	MIT	Weisner 54		
Lerobee	SM2.06	Churchill	25 Aug '57	08.08	COT	Stroud 60		
Merobee	s c-8	Warc	14 Jul '50	01.57	Mot	Stroud 56		L
Merobec	SC-14	wspc	11 Dec '50	20.06	MOT	Stroud 56		
lerobe e	sc-18	Wapc	8 Jun '51	23.11	MBT	Stroud 56		200
					-			
						-		



cen from a published curve. Interpolation for tabular presentation may have introduced an error of \$ 56.

UPPER ATMOSPHERE STRUCTS
Measurements Reported Through

Altitude	Pressure	Density	Temperature	
Km.	mm.Hg. e.%	g/m² e.%	*K e. *K	Instrumentation Vehicle Number ALTITUE RAKES 40-50 Ex.
				AMIITOM AMON 40-50 MR.
40	2.0 10			Phillips gage* V-2 21
40	3.0 (m²)		• •	Pireni gage* V-2 28
40	2.0 10	• •		Phillips gage* V-2 45
40	3.0 (mf)		265 5.0	Alphatron Aerobee (nf)
1,0	3.0 (nf)		271 5.0	Alphatron Aerobee (nf)
40		• •	277 8.0	Alphatron Aerobee (nf)
40	• •	4.5 (nf)		Sphere* Aerobee SC-29
40	• •	4.5 (m²)	• •	Sphere* Aerobee SC-30
40	• •	4.5 2	• •	Sphere* Aerobee SC-31
40	• •.	3.8 .28	272 16	Sphere* DAN-2 AM7.0
40	. •	3.0 (m²)		Ionization gage* Aerobee AM2.2
40		3.2 2	240 4.8	Sphere* Nike-Cajun AM6.1
40		3.2 2	233 4.6	Sphere* Nike-Cajum AK6.1
40	8.0x10 ⁻¹	1.71 (nf)	240 3.0	Grenade Aerobee (M1.0
40	17 (nf)	3.3 (nf)	265 3.0	Grenade Aerobee SML.0
40	2.1 (nf)	4.1 (nf)	256 5.0	Grenade Aerobee SM1.0
40	2.0 (nf)	3.8 (nf)	260 3.0	Grenade Aerobee SM1.0
40	2.5 (nf)	5.1 (nf)	258 3.0	Gremade Aerobee SM1.0
40	• •	• •	252 3.0	Grenade Aerobee SM2.0
40		• •	245 3.0	Grenade Aerobee SM1.0
40	1.2 (nf)	2.2 (nf)	227 3.0	Grenade Aerobee SM1.0
40		3.7 2	223 4.5	Sphere* Nike-Cajun AM6.0
40	• •	2.3 2	250 5.0	Sphere* Aerobee SM2.1
40	1.0 (nf)	2.1 (nf)	233 3.0	Grenade Aerobee SM2.1
40	1.5 (mf)	3.1 (nf)	225 3.0	Grenade Aerobee SM1.0
40		J.0 2	288 5.6	Sphere Nike-Cajun AM6.0
1	٠			* These entries are taken from published



OSPHERE STRUCTURE DATA Reported Through Early 1960

Vehicle	Number	Place Fired	Date	Time	Zone	Reference Data	Notes	Altitud Range, :
TE RANGE 40-5	50 Km.							
A- 5	21	WSPG	7 Mar '47	11.23	MT	IaGov 54		
A-5	28	WEPG	8 Dec '47	14.42	Met	Spencer 54	(mf) = not found	
V-2	45	WEPG	28 Jan '49	10.20	TEM	Indow 54		
Aerobee	(nf)	WEPG	20 Jun '50	08.38	MET	Sicineki 54		
Aerobee	(mf)	WEEPC	13 Sep '51	04.37	MST	Sicinski 54		250
Aerobee	(mf)	Wapc	26 Sep '51	(nf)	•	Spencer 54		
Aerobee	8 C-29	WEPG	11 Dec '52	(nf)	-	Jones 58		
Aerobee	80-30	WEPG	23 Apr '53	(mi')	•	Jones 58		
Aerobee	SU-31	WEEPG	29 Sep '53a	(nf)	•	Jones 58		
DAN-2	AM7.02	Wallops	24 Jun 155	13.04	est	Jones 56		200
Aerobee	AM2.21	Churchi 11	23 Oct 156	02.40	CST	Spencer 58-1		200
Nike-Cajun	AM6.10	N.Atlantic	4 Nov '56	12.54	CHET	Jones 59	57°46'N 46°41'W	
Nike-Cajun	AM6.12	W.Atlantic	10 Nov '56	07.17	CD4CT	Jones 59	65°36'# 58°03'W	
Aerobee	SM1.01	Churchi 11	12 Nov 156	05.48	CST	Stroud 60 & Be	ndeen	
Aerobee	8941.02	Churchill	21 Jul '57	22.16	CST	Stroud 60 & Be	undeem.	
Aerobee	8941. 03	Churchill	23 Jul '57	23.50	C27:	Stroud 60 & Be	indeen	186
Aerobee	8141.04	Churchill	12 Aug '57	10.00	can	Stroud 60 & Be	ndeen	
Aerobee	8M1.05	Churchill	19 Aug 157	20.30	JST	Stroud 60 & Be	undeen 💮	
Aerobec	8142 .06	Churchi 11	25 Aug 157	08.08	CST	Stroud 60		7
Aerobee	SM1. 07	Churchill	11 Dec '57	22.00	CST	Stroud 60		
Aerobee	s M1.08	Churchi 11	14 Dec 157	15.00	CST	Stroud 60 & Be	undeen	100
Nike-Cajun	AM6.02	Churchill	25 Jan '58	13.12	Cet	Jones 59		
Aerobee	8M2.1 0	Churchi 11	27 Jan 158	12.48	C9T	Jones 58		
Aerobee	8M2.1 0	Churchi 11	27 Jan '58	12.49	Cat	Stroud 60 & Be	indeen	
Aerobee	8M1.09	Churchill	27 Jan 158	00.04	CST	Stroud 60 & Be	ndeen	
Ni ke-Cajun	AM6.03	Churchi 11	29 Jan 158	13.06	CST	Jones 59		
•	-					introduced an er	man of A Ed	80

UPPER ATMOSPHERE STRUC Measurements Reported Throng

	Altitude	Pressure		Dens		Tempe				
	Km.	mm.Hg.	•.%	g/m³	•.%	·ĸ	o, °K	Instrumentation	Vehicle	Numb
								ALTI	TUIT RANGE 40-5	O Km.
	40	•	•	4.0	2	245	4.9	Sphere*	Nike-Cajun	AM6.0
	40	•	-	5.0	5	240	4.8	Sphere#	Nike-Cajun	AM6.0
							_			
	_		_			-				
	****	_			-	*****	_			
	40.5	-	•	-	-	253.4	2.3	Granade	Aerobee	8C-20
	41	2.1	(zf)	-	•	•	-	Phillips gage"	Aerobee	(m)
	41.6	•	•	•	-	251.4	1.4	Grenade	Aerobee	sc-8
	41.8	•	•	-	•	261.5	1.6	Grenade	Aerobee	8C-14
	42	1.7	(nf)	•	•	-	•	Phillips gages	A-5	34
	42	2.0	(nf)	-	-	•	-	Pressure gage*	A-5	43
	42	•	-	-	•	262	5.0	Grenade	Aerobee	SC-14
	42.1	•	•	•	•	266.5	3.2	Grenade	Aerobee	(mf)
	43.5	~	•	-	•	266.5	1.1	Grenade	Aerobee	sc-16
	45	1.44	(p)	1.8	(g)	•	-	Ionization gage	Aerobee	31
	45.11	-	-	•	-	311	(g)	Ionization gage	Velopes	31
	46.3	-	-	•	•	265	2.7	Grenade	Aerobee	SC- 50
	46.9	-	•	-	•	264.2	2.3	Grenade	Aerobee	8c-18
	47.1	-	•	-	•	257.3	0.4	Grenade	Aerobee	(nf)
	47.3	-	•	•	•	267.5	1.5	Grenade	Aerobee	sc- 8
·	47.3	-	•	-	•	255.6	3.1	Grenade	Aerobee	(nf)
	48	9.0x10 ⁻¹	(nf)	•	•	-	•	Phillips gage	(nf)	(m,)
	48.1	-	•	-	•	266	1.4	Grenade	Aerobee	8C-14
•	48.2	-	-	-	-	270	3.6	Grenede	Aerobee	(nf)
	46.3	•		-	•	262.6	1.4	Grenade	Aerobee	(nf)

¹

^{*} These entries are taken from a publishe

IOSPHERE STRUCTURE DATA ts Reported Through Early 1960

Vehicle	Nuniber	Place Fired	Date	Time	Zone	Reference Data	Notes	Altitud Range, l
TUTE RANGE 40-	50 Km.	(cont.)						300
, Hike-Cajun	AN6.05	Churchill	4 Mar 158	13.30	Cat	Jones 59		
Nike-Cajun	AM6.09	N.Atlantic	2 Nov '59	12.40	GMT	Jones 59	48°57'N 48°22'W	
•								
	***************************************	·				•		
								250
Aerobee	8C- 20	Warc	1 Nov '51	02.46	MST	Stroud 56		
Aerobee	(mf)	WSPC	3 May 149	09.14	mst	Havene 52	(nu) - not found	ĺ
Aerobes	sc-8	WSPG	14 Jul 150	01.37	Tem	Stroud 56		
Aerobee	SC-14	WSPG	11 Dac '50	21.06	net	Stroud 56		
V-2	34	WSPC	22 Jan '48	13.13	met	Bavene 52 & La	Govr 5h ·	200
A- 5	43	WSPC	5 Aug 148	18.37	Met	Havens 52 & La	Gov 54	
Aerobee	SC-14	WSPG	11 Dec '50	21.06	MST	Weisner 54		
Aerobee	(nf)	WSPC	24 Sep '52	20.50	Met	Stroud 56		1
Acrobec	s c-16	VSPG	12 Dec '50	02.10	MST	Stroud 56		ļ
Aerobee	51	Holloman	22 Oct 152	07.21	HET	Spencer 58-2	(p) - Preliminary, see reference	
Aerobee	31	Holloman	22 Oct '52	07.21	MST	Spencer 58-2		150
Aerobee	\$C- 20	WEPC	1 Kov '51	02.46	nst	stroud 56		
Acrobee	SC-18	WSPG	8 Jun '51	23.11	MST	Stroud 56		
Aerobee	(mf)	WSPG	24 Apr '53	03.19	MST	Stroud %		
Aerobee	sc- 8	W&PG	14 Jul '50	01.37	MST	Stroud 56		
Aerobee	(nf)	Wapg	22 Oct '52	20.45	MST	Strond 56		100
(nf)	(nf)	Equator	11 May '50	16.00	Met	Havens 52	near Christmas Isla	-
Aerobee	8C-14	WRPG	11 Dec '50	21.06	met	Strond 56		Ī
Aerobee	(nf)	WSPG	24 Sep '52	20.50	TEM	Stroud 36		
Astrobes	(nf)	WSPG	17 Feb '55	24.00	MST	Stroud 56		1

UPPER ATMOSPHERE STRUMOSSER STRUM

1.	Z;titude Km.	Pressure mm.Hg.	•,%	Density g/m'	•.%	Tempe •K	e, °E	Instrumentation	Vehicle	Num
٦.				<u> </u>					ALTITUDE RANCE 40-	
T.	49.9	•	•	•	•	283.7	2.2	Grenede	Aerobee	(nf
(-		-	-				
ĺ.	-									-



SPHERE STRUCTURE DATA

Project ARIES - Contract None 3071(10)

Reported	Through	Early 1960				Project ARIES	- Contract Nonr	3071(00)
Vehicle	Number	Place Fired	Date	Time	Zone	Reference Data	Notes	Altitude Ronge, Km
TUIR RANGE 40		(concluded)			·			***
Aerobee	(nf)	WSPG	31. Aug 153	22.05	TEM	Stroud 56	(rf) - not found	
				-				
					_	-		
								200
								** -
						9		
							- 1	
								上
								100
								 -

UPPER ATMOSPHERE STRUCE Measurements Reported Throu

(Altitude	Pressure		Density		Tempe	erature .			
1:_	En.	mm.Hg.	0.%	g/m'	0,%	7	o, *K	Instrumentation	Vehicle	Numbe
1.								ALT	ITUDE RANGE 50-60	Km.
Ī	50	-	•	-	•	315	25	(nf)	A-5	21
١.	50	7.5x10 ⁻¹	10	•	•	•	-	Phillips gage*	∆- 5	21
	50	9.0x10 ⁻¹	(nf)	-	•	220	(nf)	Pireni gages	∀- 2	28
,	50	7.5x10 ⁻¹	(nf)	-	•	-	-	Phillips gage"	A-5	34
Ī	5C	8.5x10 ⁻¹	(mf)	5.9x10 ⁻¹	(nf)	-	-	Pressure gage*	1-5	45
	50	6.0x10 ⁻¹	10	-	•	-	•	Phillips gage	V- 2	45
	50	6.4x10 ⁻¹	(af)	•	•	•	-	Phillips gage	Aerobee	(nf)
i	50	9.0x10 ⁻¹	(nf)	•	-	270	5.0	Alphatron*	Aerobee	(nf)
	50	-	•	•	-	265	3.0	Grenade	Aerobee	8 C-10
	50	9.5x10 ⁻¹	(nf)	•	•	268	5.0	Alphatron*	Aerobee	(z)
}	50	-	•	•	•	269	9.0	Alphatron#	Aerotee	(mf)
1.	50	•	•	1.0	(nf)	•	-	Sphere*	Aerobee	80-23
	50	0.79	(p)	8.5	(p)	-	-	Alphatron*	Aerobee	31
I.	50	-	•	1.0	(nf)	•	-	Sphere*	Aerobee	80-29
	50	•	•	1.0	(nf)	-	•	Sphere*	Aerobee	SC-30
1	50	-	•	1.0	2	•	-	Sphere*	Aerobee	SC-31
1	50	-	-	8.0x10 ⁻¹	.3	262	5.0	Sphere*	DAN-5	AM7.02
	50	•	•	1.0	(nf)	283	(mf)	Sphere#	Nike-Cajun	AM6.01
	50	•	•	1.0	(p)	•	•	bnisation gage *	Aerobee	AM2.21
	50	•	•	6.0x10 ⁻¹	2	285	5.7	Sphere#	Nike-Cajun	AM6.10
	50	•	•	6.5x10 ⁻¹	2	260	5.2	Sphere*	Nike-Cajun	AM6.12
1	50	2.2210-1	(nf)	4.5x10 ⁻¹	(mf)	260	4.0	Grenade	Aerobee	59 (1.01
	50	7.6x10 ⁻¹	(nf)	1.3	(nf)	270	4.0	Grenade	Aerobee	8941.02
1	50	5.0x10 ⁻¹	(nf)	9.2x10 ⁻¹	(±)	275	4.0	Grenade	Aerobee	SM1.03
1.	50	6.8x10 ⁻¹	(nf)	1.2	(nf)	272	4.0	Grenede	Aerobee	SM1.04
, .	50	6.6x10 ⁻¹	(n?)	1.2	(nf)	265	4.0	Granade	Aerobee	BM1.05
1.		ą.						* These entries	ere taken from e.	publich

HERE STRUCTURE DATA ported Through Early 1960

de	Number	Place Fired	Date	Time	Zone	Reference Data	Notes	Altitu Range
UNICE 50	-60 Km.							
	21	WEPC	7 Mar '47	(nf)		Best 47	(mf)~ not found	
	21	WEEL C	7 Mar 147	11.23	MST	IaGov 54	(, 10u.m	
	28	WSPC	8 Dec '47	14.42	MST	Spencer 54		
	34	:48 P G	22 Jan 148	15.13	MST	Bavens 52		
	45	WEPG	5 Aug 148	18.57	MBT	Havens 52 & La	Gov 54	29
	45	WSPG	28 Jan '49	10.20	MET	InGov 54		
bee	(nt)	WEFG	3 May 149	09.14	MST	Havens 52		
bee	(nf)	WSEC	20 Jun 150	08.38	1007	Sicineki 54		
bee	30-10	WEPG	16 Oct '50	5 T 00	MET	Weisser 54		
700	(mf)	WEIFG	13 Sep '51	04.37	MIT	Sicinski 54		
				<u>.</u>				26
bee	(mf)	WEFG	26 Sep '51	(nf)		Spencer 54		
bee	8C-23	WEEC	14 May '52	(nf)		Jones 58		
) be	71	Holloman	22 Oct '52	07.21	n at	Spencer 58-2	(p) preliminary:	
bee	8 C-29	WSPG	11 Dec '50	(mf)		Jones 58	one reference	,
pee	SC-30	Warc	23 Apr '53	(23)		Jones 58		
bee	8C-31	WEPG	29 8ep '53	13.50	MOT	Jones 58		10
2	AM7.02	Wallops	24 Jun 155	13.04	rot	Jones 56		
-Cajum	AM6.01	Wallope	6 Jul '56	15.00	ret	Jones 59		
bee	AM2.21	Churchi 11	23 Oct '56	02.40	CST	Spencer 58-1		
-Cajun	AM6.10	Ntlantic	4 Nov 156	12.54	GMT	Jones 59	57°46'# 46%1'H	
-Cajun	AM6.12	W.Atlantic	10 Nov '56	07.17	CHT	Jones 59	65°36'# 58°03'W	16
bee	891.01	Churchi 11	12 Nov 156	05.48	CST	Stroud 60 & Bas	rieen	-
bee	8941.02	Churchill	21 Jul 57	22.16	CST	Stroud 60 & Bes	ndeen -	
bee	801.03	Churchi 11	23 Jul '57	23.50	CST	Stroud 60 & Bas	ndeer	
bee	5M1.04	Churchill	12 Aug 157	10.00	CST	Stroud 60 & Sus	ndoun	
bee	8M1.05	Churchi 11	19 Aug '57	20.30	Cat	Stroud 60 & Bas		
.						ave introduced an		

Science Communication

Washington, D. C.

UPPER ATMOSPHERE STRUC Measurements Reported Throng

<u>Altitude</u>	Pressure		Density		Tempe				
Ke.	mm.Hg.	0.%	g/m³	•.%	-T	•. °K	Instrumentation	Vehicle	Number
							ALI	TTUE RAME 50-60	Km. (
50	•	•	-	-	265	4.0	Grenade	Aerobee	8 1 2.0
50	-	-	-	•	255	4.0	Grenade	Aerobee	8M1.07
50	2.4x10 ⁻¹	(nf)	4.9x10 ⁻¹	(nf)	256	4.0	Grenade	Aerobee	800.08
50	-	•	7.5x10 ⁻¹	2	253	5.1	Sphere*	Hike-Cajun	AM6.0
50	•	•	1.0	2	255	5.1	Sphere*	Acrobee	802.10
50	2.8x10 ⁻¹	(nf)	5.5x10 ⁻¹	(nf)	257	(nf)	Grenade	Aerobee	812.10
50	3.0x10 ⁻¹	(nf)	6.2x10 ⁻¹	(nf)	252	4.0	Grenade	Aerobee	801.0
50	•	•	9.5x10 ⁻¹	2	260	5.6	Sphere*	Nike-Cajum	AM6.0
50	•	•	1.0	2	265	5.2	Sphere*	Nike-Cajun	AM6.0
50	-	•	8.5x10 ⁻¹	2	255	5.1	Sphere*	Nike-Cajun	AM6.0
	-					_			
_									
_	-								
50.11	. •	-	•	•	3 09	()	Alphatron*	Aerobee	31
51	•	•	6.0x10 ⁻¹	()	•	•	Ionisation gage*	Hilm-Cajun	AM6.3
51.5	-	•	-	-	260.4	1.7	Grenade	Aerobee	s c-18
52	5.7x10 ⁻¹	4.1	•	•	•	•	Phillips gage	Aerobee	(nf)
55.1	•	•	•	•	261	5.9	Greende	Aerobee	SC-1 6
53.3	•	•	•	•	263.4	1.7	Grenede	Aerobee	SC-5 0
53.3	-	•	-	•	278.2	3.7	Grenade	Aerobee	(rf)
54	•	-	•	•	271.1	4.0	Grepade	Agroben	(nf)
54	-	•	6.0x10 ⁻¹	(p)	•	•	Ionization gages	Ni los-Cajun	AM6.3
54.7	-	•	•	•	251.5	1.7	Grenede	Aerobee	SC-14
54.7	-	٠ س			262.5	0.4	Grenade	Aerobee	(nf)
		Ţ					* These entries	are taken from a ;	u blim h

RE STRUCTURE DATA ted Through Early 1960

	Number	Place Fired	Date	Time	Zone	Reference Data	Notes	Runge
50-60	En. (cont.)			· · · · · · · · · · · · · · · · · · ·				
	SM 2.06	Churchill	25 Aug 157	08.08	CST	Stroud 60		
	800.07	Churchi ll	11 Dec '57	22.00	CST	Stroud 60		
	8M1 .08	Churchi 11	14 Dec '57	15.00	CRT	Stroud 60 & Ba	ndeen	
m	AN6.02	Churchill	25 Jan 158	13.12	Cat	Jones 59		
	312.10	Churchi 11	27 Jan '50	j2.48	CST	Jones 58		2
	802.10	Churchill	27 Jan '58	12.49	CST	Stroud 60 & Ba		
	SM1.09	Churchi 11	27 Jan '58	00.04	CST	Stroud 60 & Ba	(nf)- not found ndeen	
uen.	AM6.03	Churchi ll	29 Jan 158	13.06	Cat	Jones 59		
un	AM5.05	Churchi 11	4 Mar 158	15.30	CST	Jones 59		
ur.	AM6.09	N.Atlantic	2 Nov '59	12.40	316	Jones 59	48°27' N: 48°22' W	
_				-	69./gP			
-			•		-			
~								
	31	Hollown	22 Oct 152	07.81	MBT	Spencer 58-2	(p) preliminary, se	•
an.	AM6.38	Churchi 11	24 Mar 158	12.30	C\$T	Spencer 58-1	reference	1
	SC-1 8	WEFG	8 Jun 151	23,11	MST	Stroud 56		
	(at)	WEPG	6 Sep '49	09.57	MAT	Havens 52		
	ac- 16	WSPG	12 Dec '50	02.10	mst	Stroud 56		
	80- 20	WEPG	1 Nov '51	02.46	Met	Stroud 5.		
	(nf)	8623	22 Oct 152	20.45	MST	Stroud 56		
	(m/)	WBPG	24 Sep '5 2	20.50	MST	Stroud 56		1
un	ANS. 37	Churchill	24 Feb 158	01.35	CST	Spencer 58-1		
	sc-14	WEPG	11 Dec '50	21.06	mst	Strout. 56		
	(m)	WHPG	% Apx 153	03.19	MST	Litroud. 50		
свар	ublished cur	rve. Interpola	rios for tabula	r presentati	on may be	eve introduced an	error of ±%.	

UPPER ATMOSPHERE STRUC Measurements Reported Thron

	Altitude	Pressure		Density		Temper	rature			
.L	Km.	mm.Hg.	•.%		•,%	°K	٠, ۴	Instrumentation	Vehicle	Number
									ALTITUDE RANCE	50-60 D
1	55	•	-	•	•	252	4.0	Grenade	Acrobee	SC-14
_	55.4	•	-	•	•	265.6	4.6	Granada	Aerobeis	8C-1 3
	56	•	•	-	•	249.7	3.8	Grenade	Aerobee	೮ ೦-8
	58	5.0x10 ⁻¹	(nf)	-	•	•	•	Pressure gage*	▼ ~2	43
	58	•	-	-	•	262	3.6	Grenade	Aerobse	SC- 10
	58.1	•	-	•	•	239.9	1.9	Grenade	Aerobee	(mt)
•	58.5	•	-	•	•	259	1.6	Grenade	Aerobee	(nf)
ı	58.7	-	-	-	-	258.9	7.2	Grenade	Aerobee	2c-18
	59	2.0x10 ⁻¹		-	-	-	•	Phillips gage*	Aerobee	(nt)
Ţ	59	2.3x10 ⁻¹	(nf)	•	•	•	-	Phillips gage*	(nf)	(mf)
1	59	•	-	•	•	263.9	4.2	Grenade	Aerobee	(nf)
	59.3	•	•	-	•	246.2	1.8	Grenade	Aerobee	(at)
	59.6	-	-	•	•	254.3	3.8	Grenede	Aerobee	(m²)
1										
•	-	-	ordeli Tilla						-	



^{*} linese enivies are taken from a publishe

RE STRUCTURE DATA tod Through Early 1960

I	Number	Place Fired	Dat•	Time	Zone	Reference Data	Notes	Altitude Rauge, Km
RANCE	50-60 Em.	(numluded)						
Ð	8 C-14	WSPG	11 Dec 150	21.06	Met	Weigner 54		
Þ	ac-18	WSPG	8 Jun '51	23.11	Met	Stroud 56		
•	sc- 8	Warg	14 Jul '50	3.137	Xat	Stroud 56		
ı	43	WSPG	5 Aug 148	18.37	MOT	Bavens 52 & La	Gov 54 (nf) not:	Count -
•	S C-10	WSPC	io 0ot '50	21.00	AB7.	Welener 54		200
•	(nf)	WSPG	31 Aug 153	22.05	Mat	Stroud 56		_
P	(nf)	WEPG	4 Sep 155	22.36	Met	Stroud 56		-
•	8C-18	WSPO	8 Jun '51	25.11	MST	Stroud 56		
•	(nf)	WBPG	3 May 149	09.14	Kät	Eavens 52		
i	(nf)	Equator	11 May 150	16.00	MBC	Havens 52	near Garietmae	Island
1	(nf)	WERG	22 Oct '52	20,45	MBT	stroud 56		
1	(nf)	WBPG	1? Feb '53	25.50	181	Stroud 56		
1	(nf)	WBPG	24 Sep 152	20.50	MOT	Stroud 56		
-			***************************************		-	-		
		days		-		-		180



rom a publishe', curve. Interpolation for tabular presentation may have introduced an error of \$5%.

UPPER ATMOSPHERE STRU Measurements Reported Three

Altitude	Pressure		Density		Temp	erature			
Km.	mm.Hg.	•.%	g/m³	0,%	• <u>k</u>	e, °K	Instrumentation	Vehicle	Numbe
							ALITI	NUDE RANGE 60-7	0 Km.
60	-	-	•	-	312	25	(nf)	V-2	21
60	2.2x10 ⁻¹	(nf)	-	-	250	(m²)	Pirani gages	V- 2	28
60	-	-	5.0x10 ⁻¹	(nf)	-	-	Pressure gage	V- 2	43
60	2.5x10 ⁻¹	(nf)	-	-	240	7.0	Alphatron#	Aerobee	(nf)
60	•	•	-	•	250	5.0	Grennde	Anrobee	SC-14
60	2.5x10 ⁻¹	(nf)	-	•	238	5.0	Alphatron*	Aerobee	(mf)
60	•	-	•	-	240	12	Alphatron*	Aerobee	(nf)
60	•	•	3.5x10 ⁻¹	(nf)	-	•	Sphere*	Aerobee	SC-23
60	2.5x10 ⁻¹	(p)	2.8	(g)	277	(p)	Alphatron*	Aerobee	3).
60	•	-	4.5x10 ⁻¹	(nf)	-	•	Sphere*	Aez: Jee	sc-29
60	-	•	3.0x10 ⁻¹	(nf)	•	-	Sphere*	Aerobee	S C-30
60	•	-	2.0x10 ⁻¹	2	-	-	Sphere*	Aerobee	SC-31
60	•	•	3.17±10 ⁻¹	1	242	4.0	Sphere*	DAN-2	AM7.0
6 0	•	-	4.0x10 ⁻¹	(nf)	-	-	Sphere*	Nike-Cajun	AM6.0:
60	-	•	2.9±10 ⁻¹	(p)	-	•	Ionization gage*	Aerobee	AM2.2
60	-	•	2.0x10 ⁻¹	2	273	5.5	Sphere*	Nike-Cajun	AM6.14
60	•	•	2.0x10 ⁻¹	2	240	4.8	Sphere*	Nike-Cajun	AM6.11
60	6.6x10 ⁻²	(mf)	1.1210-1	(rt)	260	5.0	Grenade	Aerobee	SM1. 01
60	2.1x10 ⁻¹	(nf)	4.2x10 ⁻¹	(nf)	260	5.0	Grenade	Aerobee	801.04
60	1.8x10-1	(nf)	3.5x10 ⁻¹	(nf)	260	5.0	Grenale	Aerobee	SM1.03
60	1.7x10 ⁻¹	(nf)	2.7x10 ⁻¹	(nf)	258	5.0	Grenade	Aerobee	SM1.04
60	1.8x10 ⁻¹	(nf)	3.5x10 ⁻¹	(nf)	255	5.0	Grenade	Aerobee	SM1.05
60	-	•	-	-	255	5.0	Grenade	Aerobee	SM2.06
60	•	•	4.0x10 ⁻¹	(p)	•	-	Ionization gage#	Aerobee•Hi	EO. IMA
60	-	<i></i>		-	242	5.0	Grenaie	Aerobee	SM1.07
			4				* These entries are	taken from a p	ublishe

TRUCTURE DATA
Through Early 1966

Number	Place Fired	Date	Time	Zone	Reference Data	Notes	Altitud Range, 1
Kn.							300
21	WEPG	7 Mar '47	11.23	MST	Best 47	(mf) - not found	
28	WSFG	8 Dec '47	14.42	MST	Spencer 54		
43	WSPC	5 Aug 148	18.37	Met	Havene 52 & Lat	Bow 54	
(nf)	WSPG	20 Jun '50	08.38	TEM	Sicineki 54		
SC-14	WSPG	11 Dec 150	21.06	MST	Stroud 56		250
(mf)	WSEG	13 Sep '51	04.37	MST	Sicinski 54		
(nf)	WSPC	26 Sep '51	(nf.)	•	Spencer 54		
SC-23	WSPG	14 May 152	(nf)	•	Jones 58		
31	Holloman	22 Oct 152	07.21	Met	Spencer 58-1	(p) Preliminary:	
sc-29	WSPG	11 Dec 152	(nf)	-	Jones 58	ses reference	
			\,		-		200
SC-30	WSPC	23 Apr '53	(nf)	-	Jones 58		
SC-31	WSPG	29 Sep '53	13.50	MST	Jones 58	•	
AM7 .02	Wallops	24 Jun '55	13.04	est	Jones 56		
AM6.01	Wallops	6 Jul 156	13.00	est	Jones 59		
W5.51	Churchill	23 Oct 156	02.40	CST	Spencer 58-1		
AM6.10	N.Atlantic	4 Nov '56	12.54	CHE	Jones 59	57046'N 46941'W	190
AM6.12	N.Atlantic	10 Nov '56	07.17	GMT	Jones 59	65°36'N 58°03'W	
SM1. 01	Church111	12 Nov 156	05.48	CST	Stroud 60 & Bas	ndeen	
841.02	Churchill	21 Jul '57	22.16	CST	Stroud 60 & Bar	ndeen	
SM1.03	Churchi 11	23 Jul '57	23.30	CST	Stroud 60 & Ber	ndeen	
ewa ok	en	10 Aug 199			Stroud 60 & Bas	man I	Jŧ
SM1.04 SM1.05	Churchi 11	12 Aug '57	10.00	CST			E 100
	Churchill	19 Aug '57	20.30	CST	Stroud 60 & Bas	A L	
SN2.06	Churchill	25 Aug '57	08.08	CST	Stroud 60		
AM4.01	Churchill	1 Sep '57	16,28	Cat	Spencer 58-1		
SM1.07	Churchill urve. Interpo.	11 Dec '57	55.00	Cet	Stroud 60		

UPPER ATMOSPHERE STRUC
Measurements Reported Through

•	Altitude	Pressure		Density		Tempe				
╌┟	Km.	mm.Hg.	•.%	g/r.	•,%	°K	•. °K	Instrumentation	Vehicle	Number En. (c
_								AL/I	THUM KANGE 60-10	AE. (4
I	60	5.7±10 ⁻²	(mf)	1.2x10 ⁻¹	(mf)	230	5.0	Grenede	Aerobee	80.DE
T-	60	-	-	1.9x10 ⁻¹	2	263	5.2	Sphere#	Hike-Cajun	AM6.02
	60	-	•	1.5227*1	2	253	5.0	Sphere*	Aerobee	3942 .10
	60	1.1x10 ⁻¹	(mf)	2.2x10 ⁻¹	(nf)	255	5.0	Grenade	Aerobee	312. 10
l	60	7.8x10-2	(mf)	1.5x10 ⁻¹	(rd)	250	5.0	Granade	Aerobee	SM1.09
	60	-	-	3.0x10 ⁻¹	2	258	5.1	Sphere*	Nike-Cajun	AM6.03
	60	-	•	2.8x10 ⁻¹	(p)	•	-	Ionization gage	Nike-Cajun	AM6.37
	60	-	-	2.5x10 ⁻¹	5	238	4.7	Sphere*	Nike-Cajun	AM6.05
	60	-	-	2.0x10 ⁻¹	(g)	•	•	Ionization gages	Nike-Cajun	ам6.38
	60	•	•	2.9x10 ⁻¹	2	•	•	Sphere#	Ni ke-Cajun	AM6.09
ļ !			_							
	-									
ļ	-									
ļ.	60.1	•	-	•		249	2.1	Grenade	Aerobee	8C-14
,	60.5	-	-	•	-	241.8	5.8	Grenade	Aerobee	8C-20
	61	1.8x10 ⁻¹	10	-	•	•	•	Phillips gages	▼- 2	45
	61.2	-	•	•	-	211.6	1.4	Grenade	Aerobee	8 C-16
	61.8	-	•	-	•	244.6	0.4	Granada	Aerobee	(nf)
	61.9	•	•	•	•	252.2	1.3	Grenade	Aerobee	8C-18
	65	1.4x10 ⁻¹	(nf)	-	•	-	-	Phillips gage*	▼- 2	12
	64	-	-	•	-	234	5.0	Granade	Aerobec	8C-10
	64.4	-	-	•	•	233.5	4.0	Grenade	Aerobee	8C-10
	64.5	-	-	-	-	244.7	2.3	Grenade	Aerobee	8C-14
	65	•	٠,			245	5.0	Grenade	Aerobee	SC-14
				4	1			* These entries a	re taken from a D	ub 11 ah e

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OSPMERE STRUCTURE DATA Reported Through Early 1960

V	hicle	Numb	er .	Place Firod	Dat	•		Time	Zone	Reference Data	Notes	Range
Π	RANGE 60-70	En.	(cont.)									
M	erobee	810.0	8	Churchill	24 1	Dec (57	15.00	CST	Stroud 60 & Bas	deen	
H:	ike-Cajun	ANS.O	2	Churchill	25 .	Jan '	58	13.12	CST	Jones 59		
M	erobee	3 12.1	.0	Churchi 11	27 3	Jan '	58	12.48	CHT	Jones 58		
A	erobee	SN2.1	.0	Churchill	27 3	Jan '	58	12.49	Cat	Stroud 60 & Bas	ndeen	
M	exobee	SM1.0	9	Churchill	27 3	Jan '	58	00.04	CST	Stroud 60 & Bas	ndeen.	20
N:	ike-Cajun	AM6.0	3	Churchill	29 3	Jan '	58	13.06	CST	Jones 59		
N:	ike-Cajun	AM6.3	7	Churchill	24 I	eb '	· 5 8	01.35	CST	Spencer 58-1	(p) Preliminary:	
N:	ike-Cajun	AM6.0	5	Churchill	4 1	Mar '	58	13.30	CST	Jones 59	see reference	
N:	ike-Cajun	AM6.3	8	Churchi 11	24 1	tar '	58	12.30	CST	Spencer 58-1	(mf)- not found	
H:	ike-Cajun	AM6.0	9	W.Atlantic	2 1	lov '	59	12.40	CHET	Jones 59	48°57'3 48°22'W	20
•			_									
-			_					-				
-			-				_					
A	eropee	8C-14	•	WEIPG	n i	Dec '	50	21.06	KST	Stroud 56		
A	erobee	80-5 0	•	WEIPG	11	lov '	51	02.46	MST	Stroud 56		19
¥	-2	45		WBPG	28 (Jan '	9	10.20	MST	Indov 54		
A	erobee	8 C-16	;	WBPG	12 1	Dec '	50	02.10	MST	Stroud 56		
A	erobee	(mf)		WSPG	24 /	Apr '	'53	03.19	MOT	Stroud 56		
A	erobee	8¢-1 8	}	WEPG	8 .	Jun '	751	23.11	MST	Stroud 56		
V	-2	12		WRPG	10	Oct	46	11.02	Met	Havens 52		••
A	erobee	8C-10)	WSPG	16	Oct '	50	21.00	MST	Stroud 56		10
A	erobee	80-10)	WEPG	16	Ost '	50	21.00	MST	Stroud 56		
A	erobee	8C-14		WERG	n	Dec	150	21.06	Met	Stroud 56		
A	erobee	SC-14	•	Warc	n :	Dec	50	21.06	Mat	Stroud 56		
1.1	aken from a n	ub 14 ek	ed curv	e. Internol	ation	for	tahul	770000000000000000000000000000000000000		(1.ntroduced en (

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UPPER ATMOSPHERE STRUCT

	Altirude	Pressure		Density		Tempe	roture			
·L	Km.	mm.Hg.	•.%	g/m²	•.%	, <u>k</u>	•. °K	Instrumentation	Vehicle	Number
•									ALTITUDE RANCE	60-70 Km.
	65	1.09x10 ⁻¹	(nf)	•	-	•	•	Phillips gage*	(1 2)	(nf)
	65.7	-	-	•	-	236	1.9	Grenade	Mrobee	(nf)
I	65.8	-	•	-	-	224.5	1.4	Grenade	Aerobee	(nf)
7	\$6.6	-	•	•	•	223.4	1.8	Grenade	Aerobee	(㎡)
I	67.3	-	•	•	•	222.1	1.8	Grenude	Aerobee	(mf)
I	68	7.0x10 ⁻²	(nf)	-	•	-	-	Phillips gage*	(nf)	(mf)
•	68.1	-	•	-	-	222.6	0.4	Grenade	Aerobee	(nf)
1	69.3	-	•	•	•	235.3	1.8	Grenade	Aerobee	(mf)
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^{*} These entries are taken from a publishe

DSPMERE STRUCTURE DATA Reported Through Marly 1960

Project ARIES — Contract Nonr 3071(00)

Vehicle	Number	Ploce Pired	Date	Time	Zone	Reference Data	Notes	Altitude Range, Ku
LITTUTE RANGE	60-70 Km. (cor	mluded)						
(nf)	(nf)	WEPG	12 Dec '50	24.00	MST	Havens 52	(nf)- not found	
Nerobee	(m²)	WEPG	31 Aug '53	22.05	MOT	Stroud 56		
Asrobee	(nf)	Warg	4 Sep 155	22.36	MOT	Stroud 56		
Aerobee	(mt)	WEPG	22 Oct '52	20.45	MET	Atroua 56		-
Acrobee	(nf)	WSPG	24 Sep '52	20.50	Tem	Stroud 56		250
(nf)	(nf)	Equator	11. May 150	16.00	изт	Havens 52	near Christmas Is	land
Aerobee	(nf)	WSPG	24 Apr 153	03.19	men	Stroud 56		-
Aerobee	(nf)	WSPG	17 Feb 153	23.50	Ten	Stroud 56		<u> </u> _
								200
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are taken from a published curve. Interpolation for tabular presentation may have introduced an error of \$ 5%.

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UPPER ATMOSPHERE STRU Measurements Reported Three

	Altitude			Density		Toma	D			ARO
	Rm.	mm.Hg.	•.%	7/20	•.%	•K	e, °K	Instrumentation	Vehicle	Numb
									TUDE RANGE 70-80	
1	20	C 0-10 -9	4 41						,	— ·
•	70	6.0z10 ⁻²		•	•	•	•	Phillips gage	▼- 2	12
	70	3.5x10 ⁻³	(p)	•	•	•	-	Ionization gage*	A-5	15
-	70	•	•	-	•	540	15	(nf)	▼- 2	21
T	70	5.2x10 ⁻²	10	1.29x10 ⁻¹	20	-	•	Phillips gage"	A-5	21
Z.	70	9.0x10 ⁻²	(P)	•	•	260	(p)	Pirani gage*	▼- 2	28
1	70	5.0x10 ⁻²	(nf)	-						
ı	70	4.8x10 ⁻²		•	•	•	•	Phillips gage*	A-5	34
1	-	4.0XTM	(nf)	-	•	187	10	Alphatron	Aerobee	(z)
ì	70	•	•	•	-	225	6.0	Grenade	Aerobee	80-10
1	70	•	•	•	•	189	7.0	Alphatron*	Aerobee	(z)
!	70	5.0x10 ⁻²	(p)	8.0x10 ⁻²	(,)	216	(p)	Alphatron*	Aerobee	31
	70	•	-	1.0x10 ⁻¹	(nf)	•	-	Mahanan M		_
į	76	•	-	9.8x10 ⁻²	(nf)		-	Sphere*	Aerobee	8C-29
	70	•	_	5.5×10 ⁻²	•	•	•	Sphere*	Aerobee	80-30
ι.	70	_	-		2	•	-	Sphere*	DAN-5	AM7.Q
[-	•	•	1.0:10	5	•	•	Spher e"	Wike-Cajun	AM6.0
Î	70	•	•	5.0x10 ⁻²	2	245	4.9	Sphere*	Hike-Cajun	W6.1
:	70	•	•	6.0x10 ⁻²	2	•	•	Sphere*	Mil language design	****
	70	4.0x10 ⁻²	(nf)	9.9×10-2	(nf)	215	6.0	Grenade	•	AM6.1
	70	4.6x10-2	(nf)			220	6.0		_	801.0
	70	4.2x10"2	(nf)		•			Grenade		841.0
	70	7.544	(141)		(nf)	215	6.0	Grenade		a (1.0
	10	•	•	•	•	210	5.0	Grenade	Aerobee	8M2.0
	70	•	•	9.5x10 ⁻² ((p)	-	•	Ionization gage*	Aerobee-hi	AM.0
	70	-	•	•	-	280	6.0	Grenad:		
,	70	2.0x10-2	(nf)	2.5x10 ⁻²	(nf)	240	6.0	Granade		8M1.0
	70	-	•	5.5x10 ⁻²	-	243	4.9			810.0
	70	•	•	4.0x10 ⁻²		233	4.6	Sphere*		AM6.OI
	Í			710440	L	~)]	4.0	Sphere*		812.1
!	7	7	I					* These entries are	taken from a pul	bli ab

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	Vehicle	Number	Place Fired	Date	Time	Zone	Reference Data	Notes	Altitude Range, I
LTI	TUIR RANGE 70-80	En.							m
	V- 2	12	WEPG	10 Oct '46	11.00	284	Savene 52	(nf) not found	
*	A-S	15	WEPG	21 Nor 146	09.55	~·I	Spencer 54	(p) preliminary	
	▼- 2	21	WSPG	7 Mar '47	11.23	MOT	Best 47	see reference	
	∀- 2	21	WEPG	7 Mar '47	11.23	MOT	Indow 54		
	∆- 5	28	MEPG	8 Dec '47	14.42	MGT	Spencer 54		200
	A-5	34	HIEG	22 Jan '48	15.15	MOT	Eavens 52		
	Aerobee	(m²)	WERG	20 Jun '50	08.38	168T	Sicimic 54		
	Aerobee	8C-1 0	WEFG	16 Oct '50	21,00	MST	Stroud 56		
	Aerobee	(nt)	WEPG	13 Sep '51	04.37	MET	Sicinski 54		
	Aerobee	31	Holloman	22 Oct '52	07.21	1691	Spencer 58-2		200
	Vezopen	8 C-29	WSPG	11 Dec '52	(mf)		Jones 58	ν	
	Aerobee	SC-30	WSPC	23 Apr '53	(mf)		Jones 58		
	DVR-5	AM7.02	Vallope	24 Jun '55	13.04	ROT	Jones 56		
	Nike-Cajun	AM6.01	Wallops	6 Jul '56	13.00	ROT	Jones 59		
	Hike-Cajun	AM6.10	W.Atlantic	4 Hov '56	12.54	CHE	Jones 59	57 ⁰ 46'# 46°41'W	
	Ni ke-Cajun	AM6.12	N.Atlantic	10 Nov '56	07.17	OME	Jones 59	65°56 W 58°03'W	190
	Aerobee	antros	Churchi 11	21 Jul '57	22.16	CEET	Stroud 60 & Ber	ndoen.	
	Acrobee	80.03	Churc: '11	23 Jul '57	25.30	CET	Stroud 60 & Bar	ndeen.	
	Aerobee	841.05	Churchi 11.	19 Aug '57	20.30	CEET	Stroud 60 & Bar	deen	~
	Aerobee	842. 06	Churchi 11.	25 Aug 157	08.08	CET	Stroud 60		
9 #	Aerobee-hi	AM .01	Churchi 11	1 Sep '57	16.28	CST	Spencer 58-1		100
	Aerobee	BM1.07	Churchill	11 Dec '57	22.00	CST	Stroud 60		
	Aerobee	80.08	Churchi 11	14 Dec 157	15.00	CET	Stroud 60 & Ban	deen	
	Nike-Cajun	WH6.02	Churchi 11	25 Jan 158	13.12	COT	Jones 59		
	Aerobee	8142.10	Churchi 11	27 Jan 158	12.48	CST	Jones 58		

are taken from a published curve. Interpolation for tabular presentation may have introduced an error of 2 %.

UPPER ATMOSPHERE STRUC

Altitude	Pressure		Density		Temperature				
Km.	mm.Hg.	•.%	g/m³	0.%	·K	•. °K	Instrumentation	Vehicle	Numb
							A	LATITUTE RANGE 70-80	En.
			. م						
70	3.0x10 ⁻²	(mf)	^چ منعر .6	(mf)	238	6.0	Granade	Aerobee	202.
70	1.7x10 ⁻²	(mf)	3.7x10-2	(mf)	235	6.0	Grenede	Astobes	sia.
70	•	•	8.5x10 ⁻²	2	242	4.8	Sphere*	Hi ke-Cajum	AM6.
70	•	•	1.2 <u>x1</u> 0 ⁻¹	(P)	•	•	Ionization gage	Hike-Cajum	AMS.
70	•	•	1.0×10 ⁻¹	2	247	4.9	Sphere*	Hibe-Cajum	AM6.
70	•		5.0x10 ⁻²	(P)	•	-	Iomization gage*	Hike-Cajum	AM6.
70	•	-	6.5x10 ⁻²	(nf)	•	-	Sphere*	Hike-Cajun	AM6.
-	هندي کني	_							
-		-	-	-	-				
-	-	-			******				
70.1	•	•	•	•	224.4	4.8	Grenade	Aerobee	8C-14
72.5	•	•	•	•	207.1	2.1	Grenede	Aerobee	(nf)
72.7	•	•	•	-	240.6		Grenade	Aerobee	(m²)
75	•	-	-	•	226.0	6.0	Orenede	Aerobee	8 C-10
75.4	•	-	•	•	225.5		Granedo	Aerobee	8C-10
,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,									
76.5	-	-	•	•	204.3	2.8	Grenade	Acrobec	(nf)
77	2.6x10 ⁻¹	(nf)	•	-	•	•	Phillips gage*	Agrobes	(mf)
77.8	•	-	•	•	214.5	1.8	Orecede	Valopse	(mf)
78.7	•	•	•	•	203.4	3.0	Grande	Aerobee	(nt)
_					e-livelitanges				
		-				-			
		*****	-						



^{*} Those entries are taken from a published

PHERE STRUCTURE DATA provided Through Early 1960

hicle	fumber	Piace Fired	Date	Time	Zone	Reference Data	Notes	Altitud Range, 1
B RANGE 70-80	En.	(concluded)						
robee	86. 10	Churchill	27 Jan '58	12.49	CHT	Stroud 60 a Bas	ndeen	
robee	au1.09	Churchi 11	27 Jan '58	00. 0	CET	Stroud 60 & Bai	odee a	ļ
be-Cajun	AM6.03	Churchi 11	29 Jan '58	13.06	COT	Jones 59		
bCajun	AM6.37	Churchill	24 Feb '58	01.35	CBT	Spencer 58-1	(p) preliminary	
be-Cajun	AM6.05	Churchi 11	4 Mar 158	13.50	CET	Jones 59	see reference	200
ke-Cajun	AM6.38	Churchill	24 Mar '58	12.50	COT	Spencer 58-1		
ke-Cajun	AM6.09	W.Atlantic	2 Nov 159	12.40	CHC	Jones 59	(mf) not found 48057'H 48022'W	
				-	-		•••	
					مالات مالات			200
robae	8C-10	WEFG	16 Oct '50	21.00	MET	Strong 56		
robee	(nf)	WSPG	4 Sep 193	22.36	784	Stroud 56		
robee	(mf)	WEPG	31 Aug 153	22.05	MET	Stroud 56		
robee	8C-1 0	WEPG	16 Oct. 150	21.00	MOT	Stroud 56		
robee	8C-1 0	WEPG	16 Oct '50	21.00	MBT	Stroud 56		140
robee	(m)	WEPG	% Sep 152	20.50	MOT	Stroud 56		
robee	(mf)	WEPG	3 May 149	19.14	Met	Nevens 52		
robee	(mf)	MEPG	17 Feb 153	23.50	TOM	Stroud 56		
robee	(mf)	WEIPG	4 Sep '53	22.36	mat	Atroud 56		
		•					2	***
	***********			Translation (China				100

aken from a published curve. Interpolation for tabular presentation may have introduced an error of 🖠 %.

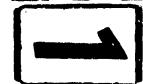
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UPPER ATMOSPITERE STRUC' Measurements Reported Throug

Altitude	Pressure		Density		Temperature				
Km.	mm.Hg.	•.%	g/m³	o. %	•K	•. "X	instrumentation	Vehicle TUER RANCE 80-9	Numbe
							ALAT	IUZE RABUE GU-9	U AM.
80	1.0x10 ⁻³	(P)	-	•	•	-	Ionization gage	4- 5	15
80	•	•	•	•	200	20	(nf)	4- 5	21
80	•	•	3.5z10- -	20	-	•	Thillips gage*	A-5	21
80	1.3x10 ⁻²	(mg)	•	•	850	(mt)	Pireni gage	4-5	28
80	•	•	-	•	210	7.0	Grenade	Aerobee	8C-1 0
80	•	-	3.0 <u>±</u> 10 ^{−2}	(mf)	•	-	Sphere*	Aerobee	80-30
80	•	•	2.0=10-2	(mf)	-	-	Aphere"	Hibe-Cajus	AM6.0
80	•	-	1.8x10 ⁻²	5	•	-	Sphere*	Hike-Cajun	AM6.1
80	•	•	2.5x10 ⁻²	5	•	•	Sphere*	Hibe-Cajun	AM6.1
80	8.7±10 ⁻²	(nf)	2.5x10 ⁻²	(nf)	174	7.0	Grenade	Aerobee	200. (
80	9.0x10 ⁻⁵	(nf)	2.6x10 ⁻²	(nf)	170	7.0	Grenade	Aerobee	201. (
80	7.4x10 ⁻³	(mf)	2.1x10 ⁻²	(nf)	172	7.0	Granade	Aerobee	.Dis
80	•	•	-	•	180	7.0	Gremule	Acrobec	800.
80	•	•	-	•	555	7.0	Grenade	Velopes	81 0.0
80	•	•	1.5×10-2	8	-	•	Sphere*	Hilm-Cajun	AM6.
80	•	•	1.0x10 ⁻²	2	-	•	Sphere*	Aerobee	86 .
80	5.5x10 ⁻⁵	(mf)	1.1x10 ⁻²	(nf)	245	7.0	Grenade	Aerobes	9 0.
80	6. lx10 ⁻⁵	(nf)	7.5x10 ⁻³	(nf)	245	7.0	Granade	Acrobec	æd.
80	•	•	2.5x10 ⁻²	5	•	-	S _e here*	Ni bo "Cajun	AM6.
80	•	-	3.5x10 ⁻²	(p)	-	•	lonisation gage	Nike-Cajun	AM6.
80	•	•	2.0x10 ⁻²	(p)	•	-	Sphere*	Ni ke-Cajun	AM6.
80	•	•	1.3210-2	(p)	•	~	Ionization gage*	Mike-Cajun	AM6.
-					*********	-			

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^{*} These entries are taken from a published

Dr.	كالمستنوس المبارية والماكا					Notes
15	WEPG	21 Nov '46	09.55	MIT	Spencer 54	(p) preliminary;
21	WEFC	7 Mar 147	17.52	MAT	Bast 47	see reference (uf) not found
21	WEFG	7 Mar '47	11.23	1001	Iallow 54	
28	WEFG	8 Dec '47	14.42	NaL	Spencer 54	
8 C-10	MEPG	16 Oct '50	27.00	XST	Stroud 56	
80-30	WERG	23 Apr '53	(mf)		Jones 58	
AMS.01	Wallops	6 Jul '56	15.00	BOT	Jones 59	
AM6.10	N./itlantic	4 Nov 156	12.54	CHE	Jones 59	57°46'# 46°41'W
AN6.12	W.Atlantic	10 Nov '56	07.17	CHE	Jones 79	65°36'# 58°05'W
200.00	Churchill	21 Jul '57	22.16	CET	Stroud 60 & Bas	deen
20 1.03	Churchill	25 Jul '57	23.30	CAT	Strond 60 & Bas	nd cen
810.05	Churchi 11	19 Aug '57	20.30	COT	Stroud 60 & Bas	ndeen
802. 06	Churchi 11	25 Aug '57	08.08	CST	Stroud 60	
80. .08	Churchi 11	1A Dec '57	15.00	CST	Stroud 60	
AM6.02	Churchi 11	25 Jan. 158	15.12	CET	Jones 59	
802.10	Churchill	27 Jan '58	12.46	CST	Jones 58	
8962.10	Churchill	27 Jan 158	12.49	CST	Stroud 60 & Bar	nteen
811.09	Churchi 11	27 Jan 156	00.0	CET	Stroud 60 & Bar	wieen
AM6.05	Churchill	29 Jan '58	13.06	CST	Jones 99	
AM6.37	Churchill	24 Feb - 58	01.35	CET	Spencer 58-1	
AM6.05	Churchi 11	4 Mer 158	13.30	CST	Jones 59	
AM6.38	Churchill	24 Mar 158	12.30	CET	Spencer 58-1	
				_		
						
	21 21 28 8C-10 8C-30 AM6.01 AM6.10 AM6.12 8M1.03 8M1.05 8M2.06 8M1.05 8M2.06 8M2.06 8M2.10 8M2.10 8M2.10 8M2.10 AM6.02 AM6.02	21 MEFG 21 MEFG 28 MEFG 8C-10 MEFG 8C-10 MEFG 8C-30 WEFG AM6.01 Wallops AM6.10 M./tlantic AM6.12 M.Atlantic 8M1.02 Churchill 8M1.03 Churchill 8M2.05 Churchill 8M2.06 Churchill 8M2.06 Churchill 8M2.06 Churchill 8M2.06 Churchill AM6.02 Churchill 8M2.10 Churchill 8M2.10 Churchill 8M2.10 Churchill 8M2.10 Churchill AM6.03 Churchill AM6.05 Churchill AM6.05 Churchill	21 MERG 7 Mar '47 28 MERG 8 Dec '47 8C-10 MERG 16 Oct '50 8C-30 WERG 25 Apr '53 AM6.01 Mallops 6 Jul '56 AM6.10 W./(tlantic 4 Mov '56 AM6.12 W.Atlantic 10 Mov '56 8M1.02 Churchill 21 Jul '57 8M2.03 Churchill 25 Jul '57 8M2.06 Churchill 19 Aug '57 8M2.06 Churchill 27 Jan '58 AM6.02 Churchill 27 Jan '58 8M2.10 Churchill 27 Jan '58 8M2.10 Churchill 27 Jan '58 8M2.10 Churchill 27 Jan '58 AM6.03 Churchill 27 Jan '58 AM6.05 Churchill 29 Jan '58 AM6.05 Churchill 29 Jan '58 AM6.05 Churchill 29 Jan '58 AM6.07 Churchill 29 Jan '58 AM6.07 Churchill 29 Jan '58	21 MBFG 7 Mar '47 11.23 21 MBFG 7 Mar '47 11.23 28 MBFG 8 Dec '47 14.42 26 MBFG 16 Oct '50 21.00 26-30 MBFG 16 Oct '50 21.00 27 Apr '53 (nf) AM6.01 Mellops 6 Jul '56 13.00 AM6.10 H./tlantic 4 Mov '56 12.54 AM6.12 H.Atlantic 10 Mov '56 07.17 280.02 Churchill 21 Jul '57 22.16 280.03 Churchill 23 Jul '57 23.30 280.05 Churchill 29 Aug '57 20.30 2802.06 Churchill 29 Aug '57 08.08 2802.06 Churchill 29 Aug '57 08.08 2802.06 Churchill 29 Jan '58 13.12 2802.10 Churchill 27 Jan '58 12.48 2802.10 Churchill 27 Jan '58 12.48 2802.10 Churchill 27 Jan '58 12.49 2801.09 Churchill 27 Jan '58 12.49 2801.09 Churchill 27 Jan '58 12.49 2801.09 Churchill 27 Jan '58 13.06 AM6.03 Churchill 29 Jan '58 13.06 AM6.05 Churchill 29 Jan '58 13.06 AM6.07 Churchill 24 Feb '58 01.35	21 MEFG 7 Mar '47 11.23 MEF 21 MEFG 7 Mar '47 11.25 MEF 28 MEFG 8 Dec '47 14.42 MFF 28C-10 MEFG 16 Oot '50 21.00 MEFT 8C-10 MEFG 25 Apr '53 (mf) AM6.01 Mallops 6 Jul '56 13.00 MEFT AM6.10 M.//tlantic 4 Mov '56 12.54 OMF AM6.12 M.Atlantic 10 Nov '56 07.17 OMF 2M0.02 Churchill 21 Jul '57 22.16 OMF 2M0.03 Churchill 25 Jul '57 20.30 OMF 2M0.05 Churchill 25 Aug '57 20.30 OMF 2M0.06 Churchill 25 Aug '57 08.08 OMF 2M0.08 Churchill 25 Jul '57 15.00 OMF 2M0.08 Churchill 25 Jul '58 13.12 OMF AM6.02 Churchill 27 Jul '58 12.48 OMF 2M2.10 Churchill 27 Jul '58 12.49 OMF 2M2.10 Churchill 27 Jul '58 13.06 OMF 2M1.09 Churchill 27 Jul '58 13.06 OMF AM6.05 Churchill 29 Jul '58 13.06 OMF AM6.05 Churchill 29 Jul '58 13.06 OMF AM6.07 Churchill 24 Feb '58 01.35 OMF	21 MERG 7 Mar '47 11.23 MET Latow 54 21 MERG 7 Mar '47 11.23 MET Latow 54 28 MERG 8 Dec '47 14.42 M91 Spencer 54 28c-10 MERG 16 Oct '50 21.00 MET Stroud 56 28c-10 MERG 16 Oct '50 21.00 MET Stroud 56 28c-50 MERG 23 Apr '53 (mf) Jones 59 AM6.01 Mellops 6 Jul '56 15.00 MET Jones 59 AM6.10 H.//tlantic 4 Nov '56 12.54 GMET Jones 59 AM6.12 H.Atlantic 10 Nov '56 07.17 GMET Jones 59 28cl.02 Churchill 21 Jul '57 22.16 CMET Stroud 60 & Bar Met 10 GM '57 22.16 CMET Stroud 60 & Bar Met 10 GM '57 20.30 CMET Stroud 60 & Bar Met 10 GM '57 80.30 CMET Stroud 60 & Bar Met 11 19 Aug '57 80.30 CMET Stroud 60 & Bar Met 11 14 Dec '57 15.00 CMET Stroud 60 Met 11 14 Dec '57 15.00 CMET Stroud 60 Met 11 14 Dec '57 15.00 CMET Stroud 60 Met 11 14 Dec '57 15.00 CMET Stroud 60 Met 11 12 Jan '58 15.12 CMET Jones 59 28cl.10 Churchill 27 Jan '58 12.48 CMET Jones 59 28cl.10 Churchill 27 Jan '58 12.49 CMET Stroud 60 & Bar Met 10 Churchill 27 Jan '58 12.49 CMET Jones 59 28cl.10 Churchill 27 Jan '58 12.49 CMET Stroud 60 & Bar Met 10 CMurchill 27 Jan '58 12.49 CMET Stroud 60 & Bar Met 10 CMurchill 27 Jan '58 13.06 CMET Stroud 60 & Bar Met 10 CMurchill 27 Jan '58 13.06 CMET Stroud 60 & Bar Met 10 CMurchill 29 Jan '58 13.06 CMET Stroud 60 & Bar Met 10 CMurchill 29 Jan '58 13.06 CMET Stroud 60 & Bar Met 10 CMurchill 29 Jan '58 13.06 CMET Stroud 60 & Bar Met 10 CMurchill 29 Jan '58 13.06 CMET Stroud 60 & Bar Met 10 CMurchill 29 Jan '58 13.06 CMET Stroud 60 & Bar Met 10 CMUrchill 29 Jan '58 13.06 CMET Stroud 60 & Bar Met 10 CMUrchill 29 Jan '58 13.06 CMET Stroud 60 & Bar Met 10 CMUrchill 29 Jan '58 13.00 CMET Stroud 60 & Bar Met 10 CMUrchill 29 Jan '58 13.00 CMET Stroud 60 & Bar Met 10 CMUrchill 29 Jan '58 13.00 CMET Stroud 60 & Bar Met 10 CMUrchill 29 Jan '58 13.00 CMET Stroud 60 & Bar Met 10 CMUrchill 29 Jan '58 13.00 CMET Stroud 60 & Bar Met 10 CMUrchill 20 CMUrchill 20 Jan '58 13.00 CMET Stroud 60 & Bar Met 10 CMUrchill 20 CMUrchill 20 Jan '58 13.00 CMET Jones 59

UPPER ATMOSPHERE

Altitude	Pressule		Density	ensity Tem		rature			
La.	maily.	•.%	g/m)	٠. ٪	°K	•. *X	Instrumentation	Vehicle	Number
							ALA	TUIE RANGE 80-9	O Km.
80.3	•	•	•	-	211.5	7.2	Grennde	Aerobee	SC-10
80.95	•	•	•	•	169	(P)	Alphatron*	Aerobee	31
82.4	7.0x10 ⁻⁵	3 0	4	•	•	•	Phillips gage	Aerobee	(ng)
83	•	-	5.5x10 ⁻³	(P)	•	-	Inmization gage*	Hile-Cajun	AM6.3
ir '	2.dx10 ⁻⁵	(P)	3.0±10 ⁻³	(P)	309	(9)	Alphatron#	Aerobee	31
دارین									~~~
	-						مواردا اجرازا اجرانا الماسي		

ALTITUDE RANGE 90-100 Km.

90	3.0x10 4	(p)		•	•	•	lonisation gages	T-2	15
90	-	-	-	•	150	(p)	Alphatron	4- 5	20
90	•	-	-	-	200	40	Pirani gage*	A-5	21
90	3.5x10 ⁻³	(mf)	•	•	550	(m²)	Pirani gage	Y-2	28
90	•	-	•	•	180	8.0	Grenade	Aerobee	892. 06
90	•	-	4.0x10 ⁻⁵	(mf)	-	•	Sphere*	Wile-Cajus	AM6.08
90	-	•	1.9x10 ⁻³	(nf)	•	•	Sphere*	Aerobee	202. 10
90	-	-	4.2x10 ⁻³	(mf)	•	•	Sphere*	Nike-Cajun	AM6.03
90	•	•	4.0x10 ⁻⁵	(mf)	-	•	Sphere*	Hibe-Cajun	AM6.05
94	1.2 <u>x1</u> 0 ⁻⁵	(mf)	-	•	•	-	Phillips gage"	A- 5	34
		~			-				
		_			-				



* These entries are taken from a published

•		rough Earl	,					Altitud
	Number	Place Fired	Date	Time	Zone	Reference Data	Notes	_ 300 <u>_</u>
Ç-ÿ	En.							}-
	80-10	WEPG	16 Ont '50	21.00	MET	Stroud 56		Ļ
	31	Holloman	22 Oct '52	C7.21	Mer	Spencer 58-2	(p) preliminary	.
	(ಹ)	HEPG	3 May 149	الد. و0	MET	Bavens 52	(nf) not found	•
	AM6.38	Churchi 11	24 Mar 158	12.30	CST	Spencer 58-1		Ī
	31	Holloman	22 Oct '52	07.21	MST	Spencer 58-2		250
-								
-	-	-				***************************************		
		-						
								200
)- <u>1</u>	00 10 n.							
	15	WEIPC	21 Nov '46	09. 55	MOT	Spencer 54		}
	20	Warc	20 Feb '47	11.16	Tem	Apencer 54		ŀ
	21	WSPG	7 Mr 147	11.23	MAI	Best 47		.
	28	WEEG	8 Dec '47	14.42	MST	Spencer 54		150
	812 .06	Churchi 11	25 Aug '57	08.08	CST	Stroud 60		150
	AM6.02	Churchi 11	25 Jan 158	13.12	CST	Jones 59		
	802.10	Churchill	27 Jan 158	12.48	CSI	Jones 58		
	AM6.03	Churchi 11	29 Jan '58	13.06	CST	Jones 59		
	AM6.05	Churchi 11	4 Mar 158	15.30	Cat	Jones 59		
	34	WEPG	22 Jan '48	13.13	Met	Hevens 52 & Li	Gov 54	100
•			-					
				-	-			
a	published o	surve. Interpol	lation for tabul	ar presentat:	lon may h	ave introduced an	error of ± 5%.	
								50
							-15-	
							•	

UPPER ATMOSPHERE STRUC Measurements Reported Through

ím.	mm.Hg.	0.%							
		4, /4	g/m³	•.%	°K	e, °K	Instrumentation	Vehicle	Number
							ALETT	DE RANCE 100-	110 Km.
100	6.0x10	(y)	-	-	-	•	Ionization gages	A- 5	15
L00	-	•	•	•	190	(nt)	Alphatvon	A-5	20
LOO	-	•	•	-	225	40	Phillips gage*	∀- 2	21
100	1.210-3	(p)	-	•	558	(z)	Pirani gage	A-5	28
100	1.1x10 ⁻⁴	30	2.5x10-4	50	510	(nf)	Phillips gage*	Viking	7
L00	•	•	-	-	198	(nf)	Phillips gage*	Aerobee-El	MW3.13
100	3.0x10 ⁻⁴	20	7.2x10-4	3 0	-	•	*	•	•
		*********				_		-	
	-	_				-		المراجع والمراجع	
							ALPIN	ЛЕ RAEGE 110~	120 Xm.
110	-	•	•	•	248	(p)	Alphatron	V-2	50
110	1.0=10-4	10	•	•	275	40	Phillips gage*	V- 2	21
110	1.4x10 ⁻⁴	(nf)	2.0x10-4	(nf)	•	•	Phillips gagen	Y-2	34
110	2.6210-5	30	5.0x10 ⁻⁵	50	228	(Lf)	Ionization gage"	Viking	7
110	•	•	1.0x10-	25	•	•	Mass Spectrometer	Acrobec-Ei	HH3.1 7
110	•	•	-	•	230	(mf)	Phillips gages*	Aerobee-Ei	MH3.13
110	6.5±10 ⁻⁵	50	1.3x10 ⁻⁴	30	•	•	•	*	•
170	•	•	4.5x10-5	25	•	•	Mas Spectrometer	Aerobee-Hi	MM3.19
115	-	-	•	•	1500	500	Languair Probe	Speciobee	ADM10,
118	•	•	•	•	1900	600	Languair Probe	Specrobes	ABM10
	_			-					
	5	7	I				* These entries ar	e taken from a	publi she
	110	1.0 - 1.0 -	1.0	100	110	100 225 100 1.2x10 ⁻³ (y) - 226 1.00 1.1x10 ⁻⁴ 30 2.3x10 ⁻⁴ 50 210 1.00 198 1.00 3.0x10 ⁻⁴ 20 7.2x10 ⁻⁴ 30 - 275 1.10 1.0x10 ⁻⁴ 10 - 275 1.10 2.6x10 ⁻⁵ 30 5.0x10 ⁻⁵ 50 228 1.10 1.0x10 ⁻⁴ 25 - 230 1.10 230 1.10 230 1.10 1.5x10 ⁻⁵ 20 1.5x10 ⁻⁴ 30 - 110 4.5x10 ⁻⁵ 25 - 1500	100 190 (mt) 1.2x10 ⁻³ (p) 228 (mt) 1.00 1.1x10 ⁻⁴ 30 2.3x10 ⁻⁴ 50 210 (mt) 1.00 3.0x10 ⁻⁴ 20 7.2x10 ⁻⁴ 30 110 1.0x10 ⁻⁴ 10 - 275 40 110 1.4x10 ⁻⁴ (mt) 2.0x10 ⁻⁴ (mt) 110 2.6x10 ⁻³ 30 5.0x10 ⁻³ 50 228 (mt) 110 1.0x10 ⁻⁴ 25 110 230 (mt) 110 230 (mt) 110 1.5x10 ⁻³ 25 110 1.5x10 ⁻³ 25 115 1500 500	Algeral Alg	190

STRUCTURE DATA Through Early 1960

Project ARIES — Contract Nonr 3071(00)

Number	Piace Fired	Date	Time	Zone	Reference Data	Notes	Altitud Range, I
Da.							
16	LIEBO	21 Nov '46	09.55	MOT	Spencer 54	(p) preliminary	
15 20	WEPG WEPG	20 Jeb '47	11.16		lipenser 54	see reference (nf) not round	
21	WEIPG	7 Mar '47	11.23	MET	Bost 47	(11) 100 101111	
58		8 Dec '47	14.42	Met	Spencer 5		
	WSPG	·	11.00	MST	Horovitz 57		250
7	WBPG	7 Aug '51	11,10	NO.T.	Holowitz 21		240
NN3.137	Churchi 11	29 Jul '57	15.59	CST	Horowitz 58		
*		•	**	M	LaGov 58		
				_			
	-	والمستوال المستوال ا	در ان بر در در		****		
				_	•		
							200
							1
O En.							
20 Th.	MIRG	20 7 cb 147	11.16	wr	Spencer 54		
20		20 Feb 147		1484. 1484.	Spencer 54 LaGov 54		
20	MEPG	7 Mar 147	11.23		Ladov 54	Gor 54	190
20 31 34	MEETG MEETG	7 Mar 147 22 Jan 148	11.23 13.13	MET	Indov 54 Havens 52 & In	00r 54	180
20 21 34 7	MEETO MEETO	7 Mer 147 22 Jan 148 7 Aug 151	11.25 15.15 11.00	MET MET	LaGov 54 Havens 52 & La Horovits 57	Gor 54	180
20 31 34	MEETG MEETG	7 Mar 147 22 Jan 148	11.23 13.13	MET	Indov 54 Havens 52 & In	gor 54	180
21 3h 7	MEETO MEETO	7 Mer 147 22 Jan 148 7 Aug 151	11.25 15.15 11.00	MET MET	LaGov 54 Havens 52 & La Horovits 57	aor 54	180
20 21 34 7	MEETO MEETO	7 Mer 147 22 Jan 148 7 Aug 151	11.25 15.15 11.00	MET MET	LaGov 54 Havens 52 & La Horovits 57	aor 54	110
20 21 3h 7 MW3.17	MEPG MEPG MEPG Churchill	7 Mer '47 22 Jan '48 7 Aug '51 20 Nov '56	11.25 15.13 11.00 25.21	1687 1687 1687 1687	Indov 54 Havene 52 & In Horowitz 57 Headows 60	gov 54	180
20 21 34 7 1003.17	MEPG MEPG Churchill Churchill	7 Mar '47 22 Jan '48 7 Aug '51 20 Nov '56	11.25 13.13 11.00 23.21	M82 M82 M82 C82	Indov 54 Havene 52 & In Horowitz 57 Meadows 60 Horowitz 58	gor 54	
20 21 34 7 303.17	WEFG WEFG Churchill Churchill " Churchill	7 Mar 147 22 Jan 148 7 Aug 151 20 Nov 156 29 Jul 157	11.25 13.13 11.00 23.21 15.59	1687 1687 C687	EnGov 54 Envene 52 & La Horowitz 57 Meedovs 60 Horowitz 58 LaGov 58	aor 54	
20 21 34 7 1003.17 1003.137	WEFG WEFG Churchill Churchill Churchill Churchill	7 Mar 147 22 Jan 148 7 Aug 151 20 Nov 156 29 Jul 157 H 23 Mar 158	11.25 13.13 11.00 23.21 15.59	1667 1667 1667 1667	LaGov 54 Bavene 52 & La Horowitz 57 Meadows 60 Borowitz 58 LaGov 58 Meadows 60	gor 54	

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UPPER ATMOSPHERE STRUC Measurements Reported Through

A	ltitude	Pressure		Density		Temp	rature			į
Ĺ	Km.	mm.Hg.	•,%	g/m¹	e.%	°K	•, °K	Instrumentation	Vehicle	Number
•								ALTER	IDE RANGE 120	-130 En.
	120	3.5x10 ⁻⁵	10	•	•	-	-	Phillips gage*	≱- -2	21
-	180	•	-	•	-	335	40	•	•	•
	120	8.0x10 ⁻⁶	30	1.2210-5	50	270	(m²)	Ionization gage*	Viking	7
7	120	•	•	2.9210-	25	-	•	Mass Spectrometer	Aerobee-Ei	1013.17
!_	120	•	•	•	-	370	(m²)	Phillips gage*	Aerobee-11	NIS.1 5
-	120	2.1x10 ⁻⁵	20	2.6210-5	3 0	•	•	•	•	*
	120	•	-	4.0x10 ⁻⁵	25	-	•	Mass Spectrometer	Aerobee-Hi	1113.18 7
	120	-	•	1.0x10-5	25	•	-	Mass Spectrometer	Aerobee-Hi	NU3-19F
	120	-	•	6.5410 5	(nf)	-	-	Satollite Orbits	(2) 1957¢, 1	957ß
	125	•		1.0z10 ⁻⁵	(mf)	•	•	Phillips gage*	¥-2	34
-										
r					-	-	-			
I. I.					1	ľ		AVIII	IDE RANGE 130	140 Km.
•		-4		<u> </u>						
•	130	3.5x10 ⁻⁶	30	3.5±10 ⁻⁶	50	428	(mf)	Ionization gas #	Viking	7
•	130	•	-	6.0x10 ⁻⁶	25	-	-	Mass Spectrometer	Aerobee-Hi	MM3.17
	130	-	-	•	•	950	(nf)	Phillips gage"	Aerobee-Hi	NN3.13
•	130	1.3×10 ⁻⁵	20	6.4210		-	•	#	n	#
	130	•	•	1.2110	25	•	•	Mar: Spectrometer	Aerobee-El	NN3.18
í	1~~	•	-	3.0x10 ⁻⁶	25	-	-	Mass Spectrometer	Aerobee-Hi	MN3.19
	1.30	-	•	3.01x10 ⁻⁵	(nf)	-	-	Satellite Orbite	(2) 1957×,	1957p
	138	-	-	•	-	1800	60C	Langmuir Probe	Spacrobec	AMILO.

SPHERE STRUCTURE DATA Reported Through Early 1960

Project ARIES — Contract Nonr 3071(00)

Vei.ide	Number	Place Fired	Date	Time	Zono	Reference Data	Notes	Altitude Range, Kr
UDE RANGE 120	0-130 En.				,			
¥-2	21	WERG	7 Mar 147	11.23	107	Ingov 54		
	*	•	•			Best 47		
Wiking	7	WEERG	7 Aug '51	11.00	10 T	Borowitz 57	(nf)- not found	
ig-sedoreA	HH3.17	Churchi 11	20 Nov '56	23.21	CET	Mandows 60		
Aerobee-E1	1115.1 3	Churchill.	29 Jul '57	15.59	CMI	Horowitz 58		250
•	#	•	•	•	•	InGov 58		-
Aerobee-Hi	NN3.18F	Churchill	21 Feb '58	20.02	COT	Mondows 60		_
Aerobee-Ili	1015.19F	Churchi 11	23 Mar '58	12.07	790	Mandows 60		ļ
(2) 1957¢, 1	1957β	-	•	-	-	Mikhnevich	Entries marked wi	
▼ -2	34	WERG	22 Jan 148	13.13	MOT	Havena 52	are based on dre for satellites cerrier rockets.	
								<u> </u>

TUDE RANGE 130-140 Km.

Viking	7	WSPG	7 Aug 151	11.00	Met	Horowitz 57
Aerobee-Hi	1013.17	Churchill.	20 Nov 156	25.21	CST	Meadows 60
Aerobee-Hi	NN3.13	Churchill	29 Jul '57	15 .59	CST	Horowitz 38
**	11	N	**	•	**	Lagov 58
Aerobee-Hi	KN3.18F	Churchill	21 Feb '58	20.02	CST	Meadows 60
Aerobee-Ei	NN3.197	Churchill	23 Mar '58	12.07	CST	Meadows 60
(2) 1957∝,	1957 / 8	-	-	•	•	Mikhnevich
Spaerobee	AM10.200	Church111	30 Nov '58	12.36	CST	Boggess 59
	Water and the same of the same		***************************************			

are taken from a published curve. Interpolation for tabular presentation may have introduced an error of † %.

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-17-

UPPER ATMOSPHERE STRU(Measurements Reported Thron

-	Utitude	Pressure		Density			erature			
-	Ľm.	mm.Hg.	•.%	g/m³	•.%	·K	•, °K	Instrumentation	Vehicle	Numbe
								ALTIN	ide ranje	140-150 Km.
	140	-	•	2.0x10 ⁻⁶	(nf)	-	-	Phillips gage*	A- 5	34
	140	2.1x10 ⁻⁶	30	1.2x10 ⁻⁶	50	700	(m²)	Ionization gage*	Viking	7
	140	•	•	1.2410-6	25	•	-	Mass Spectrometer	Aerobee-1	e wn3.17
	140	•	-	•	•	1530	(mf)	Phillips gage*	Aerobee-l	MN3.13
	140	9.9x10 ⁻⁶	20	3.0x10 ⁻⁶	3 0	•	•	и	#	*
	140	•	-	5.0x10 -6	25	•	•	Mass Spectrometer	Aerobee-i	11 RN3.18
	140	•	-	1.1x10 ⁻⁶	25	•	•	Mass Spectrometer	Aerobee-E	1 1013.19
	140	-	-	•	-	1800	350	Langmuir Probe	Spaerobee	ABHLO.
	140	•	-	1.49210-5	(nf)	-	•	Satellite Orbite	(2) 1957	κ, 1957 β
			~~							
	a-20		~~		1	1	7			
1-					1		Ī			
								ALTITU	DE RANGE	150-160 E m.
	150		•	2.0x10 ⁻⁶	(H)			ALTITU	ude range V-2	150-160 Em. '
	150 150	- 1.5x10 ⁻⁶	- 30	2.0x10 ⁻⁶ 6.6x10 ⁻⁷	(nr) 30	880	(#)			
		- 1.5x10 ⁻⁶	- 50 -		•		(at)	Phillips gage*	A- 5	34 7
	150	- 1.5x10 ⁻⁶ -	- 50 -	6. 6 10 7 5. 0 10 7	50		(#) - (#)	Phillips gage* Ionization gage*	A-5	34 7 1 NN3.17
	150 150	- 1.5x10 ⁻⁶ - - 8.2x10 ⁻⁶	- 50 - -	6.6x10 ⁻⁷	50 25	880	•	Phillips gage* Ionization gage* Mass Spectrometer	V-2 Viking Aerobee-H	34 7 1 NN3.17
	150 150 150			6.6x10 ⁻⁷ 5.0x10 ⁻⁷ - 1.9x10 ⁻⁶	50 25	880	•	Phillips gage* Ionization gage* Mass Spectrometer	V-2 Viking Aerobee-H	34 7 1 NN3.17 1 NN3.13
	150 150 150 150			6.6x10 ⁻⁷ 5.0x10 ⁻⁷ - 1.9x10 ⁻⁶ 5.5x10 ⁻⁷ 2.0x10 ⁻⁶	50 25 - 30 25 25	880	•	Phillips gage* Ionization gage* Mass Spectrometer Phillips gage*	V-2 Viking Aerobee-H Aerobee-H	34 7 1 MN3.17 1 MN3.13 "
	150 150 150 150			6.6x10 ⁻⁷ 5.0x10 ⁻⁷ - 1.9x10 ⁻⁶ 5.5x10 ⁻⁷ 2.0x10 ⁻⁶	50 25 - 30 25 25	880	•	Phillips gage* Ionization gage* Name Spectrometer Phillips gage* "	V-2 Viking Aerobee-E	34 7 1 NN3.17 1 NN3.13 1 NN3.16
	150 150 150 150 150			6.6x10 ⁻⁷ 5.0x10 ⁻⁷ - 1.9x10 ⁻⁶ 5.5x10 ⁻⁷	50 25 - 30 25 25 (at)	880	•	Phillips gage* Ionization gage* Mass Spectrometer Phillips gage* ** Mass Spectrometer Mass Spectrometer	V-2 Viking Aerobee-H Aerobee-H Aerobee-H	34 7 1 NN3.17 1 NN3.13 1 NN3.16
	150 150 150 150 150 150			6.6x10 ⁻⁷ 5.0x10 ⁻⁷ - 1.9x10 ⁻⁶ 5.5x10 ⁻⁷ 2.0x10 ⁻⁶ 8.07x10 ⁻⁶	50 25 - 30 25 25 (at)	880	•	Phillips gage* Ionization gage* Mass Spectrometer Phillips gage* * Mass Spectrometer Mass Spectrometer Satellite Orbits	V-2 Viking Aerobee-H Aerobee-H Aerobee-H (2) 1957	34 7 1 NN3.17 1 NN3.12 1 NN3.16 1 NN3.19

^{*} These entries are taken from a publishe

Vehicle	Number	Place Fired	Date	Time	Zone	Reference Data	Notes	Alti Rang St
RANCE 140)-150 Km.							
r - 2	34	WBPG	22 Jan '48	13.13	MST	Havene 52	(nf) - not found	
Aking	7	WSPG	7 Aug '51	11.00	MST	Horowitz 57		
lerobee-Ei	MN3.17	Churchill	20 Nov 156	23.21	Cat	Meadows 60		
erobee-Ei	nn3.15r	Churchill .	29 Jul '57	15.59	CST	Horowitz 58		
•	*	•	*	n	n	Ingov 58		21
erobce-Ki	NN3.18F	Churchill	21 Feb '58	20.02	CST	Neadows 60		
erobee- i i	nn3.19#	Churchi 11	25 Mar '58	12.07	CST	Headows 60		
paerobee	ABN10.200	Churchill	30 Nov 158	12.36	CHT	Boggees 59		
2) 19574,	م 1957	•	•	-	•	Mikhnevich	Entries marked with	(2)
	**********			حسن د			are based on drag for satellite and	
							carrier rockets.	24
RANGE 150)-160 En .							
7-2	34	WBPG	22 Jan '48	13.13	KST	Havens 52 and	LaGov 54	11
Mking	7	WBPG	7 Aug '51	11.00	Met	Horowitz 57		44
erobee-Ei	NN3.17	Churchill.	20 Nov 156	23.21	CSI	Meadows 60		
erobee-Ei	NN3 .159	Churchill	29 Jul 157	15.59	CST	Horowitz 58		
•	Ħ	**	*	*	*	Indow 58		
/erobee·H1	NN3.18F	Churchill	21 Feb '58	20.02	CST	Meadows 60		
i B-sedored	NN3.19#	Churchill	23 Mar 158	12.07	CST	Meadors 60		10
(2) 19574,	1957 /	-	•	•	•	Michaevi ch		
1-2	21	WSPG	7 Mar '47	11.23	MBT	InGov 54		
								

are taken from a published curve. Interpolation for tabular presentation may have introduced an error of 🛨 🤼

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UPPER ATMOSPHERE STRUC' Measurements Reported Throug

_		Pressure		Density		Temp	raiure			
	Km.	mm.Hg.	•.%	g/m'	e.%	•K	e, °K	Instrumentation	Vehicle	Number
-								ALTI	TULE RANGE 160)-170 Rm.
	160	•	-	1.5×10 ⁻⁶	(nf)	-	•	Phillips gage*	V- 2	34
-	160	1.1x10 ⁻⁶	3 0	4.3x10 ⁻⁷	50	980	(mf)	lonisation gage"	Viking	7
ŧ	160	•	•	1.5x10-7	25	-	•	Mass Spectrometer	Aerobee-fii	NN3.17
T	160	•	•	•	•	2470	(m²)	Phillips gage*	Aerobee-M	HR3.13
I	160	7.1x10 ⁻⁶	20	1.4x10 ⁻⁶	30	•	•	*	•	*
Ī	160	•	•	8.0210-7	25	-	•	Mane Spectrometer	Aerobee-Et	MN3 .18
	160	•	•	3.0x10 ⁻⁷	25	-	•	Mass Spectrometer	Aerobee- Hi	NN3.198
1.	160	•	•	-	•	1900	500	Langmuir Probe	Spacrobed	ABMLO,
j	160	•	•	4.7x10 ⁻⁶	(nf)	-	•	Satellite Orbits	(2) 1957¢,	1957#
1										
ĺ		-								

ALTITUDE RANCE 170-180 Ma.

170	8.6x10 ⁻⁷		5.0x10 ⁻⁷		1050	(mf)	Ionization gage*	Viking	7
170	-	•	8.0x10 ⁻⁸	25	•	-	Mass Spectrometer	Aerobee-E.i.	1013.17
170	•	•	•	•	2750	(nf)	Phillips gage"	Aerobee-El	103.13
170	6.3×10 ⁻⁶	50	1.1x10 ⁻⁶	30	•	•	•	•	•
170	•	•	4.0x10 ⁻⁷	25	-	•	Mass Spectrometer	Aerobee-H	MM3.18
170	•	-	1.9210-7	25	-	•	Mass Spectrometer	Aerobee-五	IN 3.198
170	•	•	2.89x10 ⁻⁶	(nf)	•	•	Satellite Orbite	(2) 1957¢, 195	57 <i>B</i>
178	•	-	-	•	1400	400	Langmuir Probe	Spacrobec	ABM10.2
			مراضعة فيبيا أثانون						



* These entries are taken from a published

SPHERE STRUCTURE DATA Reported Through Early 1966

Project ARIES — Contract Nonr 3071(00)

Vehicle	Number	Place Pired	Date	Time	Zone	Reference Data	Notes	Altitu Rango
E RANGE 160	-170 Ea.					•		
r- 2	34	WERG	22 Jan 148	15.15	1627 ,	Mayans 32	(nf)- not found	
Viking	7	WERG	7 Aug '51	11.00	1494	Ecrovite 57		
Arrobee-E1	MM3.17	Churchi 11	20 Nov 156	23.21	COT	Meadows 60		
Aerobee-EL	M3.13	Churchi 11	29 Jul 157	15.59	COST	Horowitz 58		
•	•	**	•	•	*	LaGov 58		200
Aerobee-Hi	187.18F	Churchill	21 Feb '58	20.02	COL	Headows 60		
Velopee. HT	1117 .19 F	Church111	25 Mar 158	12.07	CEET	Mandare 60		
Spacrobec	200, O.DeffA	Churchill	30 Mar 158	12.36	COT	Boggese 39		
(2) 1957a, 3	1957/	-	•	•	•	Mikhnevick	Entries marked with (2	
			•				are based on drag do for estellites and carrier rockets.	ta
OR RANGE 170-								
Viking	7	MERC	7 Aug '51	11.00	MIT	Borowitz 57		100
Aerobee fil	1013.17	Churchi 11	20 Nov 156	23.21	087	Meadows 60		
veropee-#7	1013.137	Churchill	29 Jul '57	15.59	CST	Ecrovite 58		
	•	•	•	•	•	Lagov 58		
Velopee-Fi	1115.18p	Churchi 11	21 Feb '58	20,02	COT	Meadows 60		
Aerobee-M	WH3.198	Churchill	23 Mar 158	12.07	Cet	Maadows 60		
(2) 1957¢,	1957 <i>β</i>	•	•	•	•	Mi khnevich		100
Spacrobec	ABM10.200	Churchill	30 Nov 158	12.36	CET	Boggess 59		
	-					***		

e taken from a published curve. Interpolation for tabular presentation may have introduced an error of ± 5%.

UPPER ATMOSPHERE STRUC

									•	
	Altitude	Pressure		Density		Tempe	rature			
_	Kas.	mm.Hg.	0,%	g/m³	•.%	٠K	•. °E	Instrumentation	Vehicia	Number
								<u>alpin</u>	JUE RANGE 180-	190 Km.
	1.80	6.9x10 ⁻⁷	30	2.3x10 ⁻⁷	50	1070	(z)	Ionisation gages	Viking	7
	180	•	•	5.5x10 ⁻⁸	25	•	•	Mass Spectrometer	Vetopee- Ef	NM3.1
	180	-	-	•	•	2940	(nf)	Thillips gage"	Aerobee-Ei	1013.1
	180	5.7×10-6	20	8.9=10-7	3 0	-	•	•	•	•
	180	•	•	2.5x10 ⁻⁷	25	-	•	Mass Spectrometer	Aerobee Ei	1013.1 0
	180	•	•	1.5210-7	25	-	•	Mas Spectrometer	Aerobee Mi	10/5,1 <u>0</u>
	180	-	-	1.87x10-6	(mf)	•	•	Entellite Orbite	(2) 1957a,	1957β
	186	•	•	6.7 z10⁻⁷	(nf)	•	•	Satellite drag	1958¢	•
										-
	_		_	-			-			
•										
ľ								ALFIT	ude rance 190-	200 m .
	190	5.5x10 ⁻⁷	30	1.8x10-7	50	1070	(at)	Ionisation gage	Viking	7
1	190	•	•	4.0x10-8	25	•	•	Mass Spectrometer	Veropee-HT	1013.I
•	190	•	•	•	•	2970	(mt)	Phillips gage*	Aerobee-E1	NH 5.3
l	190	5.1±10 ⁻⁶	20	7.9x10 ⁻⁷	30	•	•	•	•	
•	190	•	•	2.0210-7	25	•	•	Mass Systemater	Asrobee-El	ииз.1
	190	•	-	1.25×10-6	(nf)	•	•	Antellite Orbite	(2) 1957«,	1957 <i>p</i>
ì	197	•	•	7.0±10 ⁻⁷	(at)	•	•	Sutellite drag	1957 6	-
j								_		
_										



These entries are taken from a nublished

PREER STRUCTURE DATA Reported Through Barly 1966

Project ARIES — Contract Nonr 3071(00)

Vehicle	Number	Flace L'Ired	Date	Time	Zone	Reference Data	Notes	Altitude Range, Ka
e rance 180-	190 Km.							
Viking	7	WEPG	7 Aug 151	11.00	MAT	Horowitz 57	(mf)- not found	
Aerobee- II	NN5.17	Churchi 11	20 Hov 156	25.21	CELT	Mondows 60		
Aerobee-Hi	10073 . 1,50°	Churchi 11	89 Jul '57	15.59	CET	Ecrovita 58		⊢ i
#	•	•	•	•		Indow 58		L
Aerobee - ILi	1013 . 18p	Church111	21 7 ch 158	20,72	082	Mendors 60		200
Aerobee-EL	NN3.19P	Church111	25 Mar 158	12.07	790	Mandows 60		_
(2) 1957a, I	1957β	•	•	•	-	Mikhawich	Butries marked with (2)
1998×	•	•	•	•	•	Sobilling 59	are based on drag of for satellites and	lata
	4				_	-	cerrier rockete.	
								200
B RANGE 190-	200 Em.							-
Filting	7	WEFG	7 Aug 151	11.00	MOT	Borowits 57		
Acrobec-El	1013.17	Churchill	20 Roy 156	23.21	COT	Mendors 60		100 -
Merobee-Hi	HH3.13F	Churchi 11	29 Jul 157	15.59	780	Ecrowite 50		-
•		•	•	•	•	LaGov 58		L.i
Aerobee-Ii	NN3.18F	Churchill	21 Feb 158	20.02	COT	Mendare 60		_[_
(2) 1957«, :	19 5 7 <i>p</i>	•	•	•	-	Mikhnevich		
1957 a	•	•	-	-	•	80M 111mg 59		100

taken from a published curve. Interpolation for tabular presentation may have introduced an error of ± %.

UPPER ATMOSPHERE STRU Measurements Reported Three

	Altitude	Procure		Density		Temp	erature			
سو ل	<u> Fa</u>	mmi.g.	0,%	g/m'	•.%	• K	•, °K	Instrumentation	Vehicle	Numb
1 :							··	AIRT	UDE RANGE 200-	210 Fa.
	200	4.8x10 ⁻⁷	30	1.4=10-7	50	1070	(z)	Iomisation gage*	Viking	7
1	200	•	•	2.5x10 ⁻⁸	25	•	•	Mass Spectrometer	Aerobee-hi	1013.1°
l	200	•	•	•	-	3010	(mf)	Phillips gage	Aerobee-ki	m3.1
1	200	4.6=10-6	20	7.0±10 ⁻⁷	30	•	-	•	•	
	200	•	•	1.5 <u>x10</u> -7	25	-	•	Mes Spectrometer	Aerobee-ki	1113.1
	200	•	-	5-8.63x10 ⁻⁷	(mt)	-	-	Satellite Orbite	(2) 1957α,	1957.4
	201	•	•	6.7 z10⁻⁷	(mf)	-	•	Satellite Orbite	1997 ß	-
			~							

ALTITUDE RANGE 210-220 Da.

-		-	-		1	4)			
-	_		-		_					
2	15	•	•	1.0±10-7	(mf)	•	•	Mass Spectrometer	Aerobee-bi	M3.18
	12	-		4.8±10-7		•	•	Satellite drag	1957 / 1	•
	an .	-		4.6±10 ⁻⁷	•	•	•	Satellite Orbite	1957≪ 2	-
2	īī	•		4.6x10 ⁻⁷	•	•	•	Entellite dreg	1957 β	•
2	10	-		6.04±10 ⁻⁷	• •	•	•	Entollite Orbite	(2) 1957¢, 19	57 <i>p</i>
8	10	•	-	1.5=10-7	25	•	•	Mes Spectrometer	Aerobee-hi	183.18
2	10	4.1 <u>=1</u> 0~6	20	6.2±10 ⁻⁷	30	•	•	•	•	•
8	10	•	•	•	•	5050	(mt)	Phillips gages	Aerobee-hi	MM3.13
2	10	•	•	3.2x10 ⁻⁸	25	•	-	Mass Spectrometer	Aerobee-Mi	MM5.17
2	110	3. ≥ 10 ⁻⁷	30	1.1210-7	-	1070	(z)	Iomi sa ti on	Viking	7



^{*} These entries are taken from a published

HERE STRUCTURE DATA ported Through Early 1960

Project ARIES — Contract Nonr 3071(00)

cle	Number	Place Fired	Date	Time	Zone	Reference Date:	Notes	Altitue Remge,
MGB 800-	210 Ea.			*				300
Dg	7	WEFG	7 Aug '51	11.00	MET	Ecrovita 57	(mf)- not found	
bee-hi	1013.17	Churchi 11	20 Hov 156	25.21	087	Meadows 60	()	
bee-hi	M3.13	Churchill	29 Jul '57	15.59	cer	Morovita 58		
	*	•	•	•		Indov 58		
pee-pi	NH3.187	Churchill	21 7 cb '58	20.02	COL	Meadore 60		200
1957α,	1957 #	•	•	•	•	Mikhnevich	Entries marked with (S	9
? p	•	•	•	-	•	Sobilling 39	are based on drag de	ta
							carrier rockets.	
					_	***************************************	•	
								200
MOR 210	-220 Em.							
P¢	7	MAPO	7 Aug '51	11.00	ма	Horowitz 57		
bee-hi	WW3.17	Thurehill	20 Nov 156	23.21	COT	madove 60		
hee-hi	1015 .13F	Churchill.	29 Jul '57	15.59	CET	Horovite 58		
					•	Indov 58		100
bee-hi	1013.18F	Churchi 11	21 7eb 158	20.02	CET	Meadors 60		
1957a, :	1957 <i>6</i>	•	•	-	•	Mikhnevich		
p	•	•	•	•	•	Schilling 59		
a€ 5	•	•	•	•	•	Sobilling 59		
ß1	•	•	•	-	•	sobilling 59		100
bee-bi	NU3.18F	Churchill	21 Peb 158	20.02	CET	Mendove 60		
							The second second	
					_			

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30

UPPER ATMOSPHERE STRUC

_	<u>Altitude</u>	Pressure		Density		Temp	prature			
[_	Km.	mm.Hg.	•.%	g/m³	•.%	শ্ব	e, °K	Instrumentation	Vehicle	Numbe
-								ALTITU	DE RANGE	220-230 Km.
1	220	2.7210-8	50	9.0x10 ⁻⁶	50	1070	(nd')	Ionization gage*	Viking	;
	220	•	-	3.5-5.7×10 ⁻⁶	(nf)	-	•	Satellite (hbits	(2) 195	7a, 1957 ß
	550	•	•	4.0x10 ⁻⁷	(mf)	•	•	Antellite Orbits	1957 € 2	-
	220	•	•	•	(mf)	•	•	Satellite Orbite	1957⊄1	-
	550	•	•	4.5x10 ⁻⁷	(nf)	•	•	Satellite Orbite	1957¤ 2	•
			_							
								* These entries are	taken fr	om a publish
								A I Pri Tenti	NP DAWNP	230-240 Km.
								mas 2 2 V		2)/*E40 AB.
	230	9	•	3.52x10 ⁻⁷		•	•	Entellite Orbite	(2) 1957	iα, 1957β
	230	5.54x10 ⁻⁷	(nf)	1.79x10 ⁻⁷		938	(nf)	Discharge Manoneter	19576	-
	232	•	•	1.5x10 ⁻⁷		•	•	Satellite Orbits	1957 a 2	-
	253	_	•	2.2x10 ⁻⁷	(nf)	•	•	Satellite Orbite	(2) 1957	1B -
	255	-	•	8.2210	(mf)	•	•	Satellite drag	1957ß 1	•

				Phone-Value (COMM)	All the same of th					-
								ALTITU	DE RANCE	240-250 m .
	240	•	-	2.51±10 ⁻⁷	(nf)	-	-	Satellite Orbits	(2) 1951	l«, 1957 β
	240	1.42x10 ⁻⁷	(mf)	•	•	946	(nf)			•
	241	•	•	2.5x10 ⁻⁷	(nf)	•	•	Entellite Orbita	1957 (2	•
	-			-					-	
	-									

ERE STRUCTURE DATA pated Through Early 1960

Project ARIES — Contract Nonr 3071(00)

	Number	Place Fired	Dat•	Time	Zone	Reterence Data	Notes	Range. 300
220	-230 Km.							
	7	WEIPG	7 Aug '51	11.00	TEM	Horowitz 57	(nf)- not found	
37α,	1957 ß	-	-	•	-	Mikhnevich	Entries marked with	(5)
2	•	•	•	•	•	Schilling 59	are based on drag for satellite and	data
1	-	•	-	•	•	Sterme 58	carrier rockets.	
5	-	-	•	-	•	Sterne 58		250
			-					
	and the second	Totas	polation for tabula			to introduced en	amou of † 56.	
Trom	s hantigades c	orve. Incer	potacion for canuta	r bresenterr	on may ma	vy introduced an	error or 2 %	
230	-240 Km.							20
957a,	1957β	•	-	•	•	Mikhnevich		
	-	-	•	•	•	Mikhnevich		
2	•	•	•	•	•	Sohilling 59		
957B	•	•	•	•	•	Sterne 58		
1	-	•	•	•	•	Schilling 59		
		-			*******			156
_	-		سيداد المسيدة الأدرسوس					
	0-250 m .							
28 Ω¥0								10
				-	•	Mikhnevich		
	1957 β	•	-					
957«,	1957 β -	•	-	m	•	Mikhnevich		
957«,			- -		-	Mikhnevich Schilling 59		
		•	-	**	-			

UPPER ATMOSPHERE STRUCE Measurements Reported Through

Altitude	Pressure		Density			pratuis			
Km.	mm.Hg.	•.%	g/m²	•.%	°K	o. 'K	Insi. —entation	Vehicle	Num 250-260 I O
							PLIPITO.	ME KARLIM	270-500 M
250	-	•	1.1-1.9x10 ⁻⁷	(nf)	•	-	Satellite Orbits	(2) 195	7α, 1957β
250	3.54×10 ⁻⁷	(nf)	1.1=10 ⁻⁷	(nf)	958	(m²)	Discherge Manometer	1957 8	-
	-	-	-						
*******			***********						
							ALTITU	de range	260 -2 70 k a
260	-	•	1.51=10-7	(nf)	•	•	Satellite Orbits	(2) 195	7α, 1957 β
260	2.88x1e ⁻⁷	(nf)	8.66x10 ⁻⁸	(nf)	971	(z ř)	Discharge Manometer	19576	-
						_	-		
							Altitui	e range	270 - 280 D
270	•	•	1.19×10 ⁻⁷	(nf)	•	-	ALTITUI Satellite Orbito		270 - 280 15 74, 1957 3
270 270	- 2.35x10 ⁻⁷	- (m²)	1.19×10 ⁻⁷ 6.85×10 ⁻⁸	•	• 987	- (m²)		(2) 195	
	- 2.35x10 ⁻⁷	- (nf) -	-	(nf)	• 987 •	- (m)	Satellite Orbito	(2) 195	
270	- 2.35x10 ⁻⁷ -	- (nf) -	6.83×10 ⁻⁸	(nf)	• 987 •	- (uf) -	Satellite Orbito Discharge Manometer	(2) 1 <i>9</i> 5° 1957 6	
270	2.35x10 ⁻⁷	- (nf) - -	6.83×10 ⁻⁸	(nf)	987	- (m) -	Satellite Orbito Discharge Manometer	(2) 1 <i>9</i> 5° 1957 6	·
270	- 2.55x10 ⁻⁷ - 	- (m²) - 	6.83×10 ⁻⁸	(nf)	987	- (m)	Satellite Orbito Discharge Manometer Satellite Orbits	(2) 195 1957 8 1957 C(2	7α, 1957 β
270	2.35x10 ⁻⁷	- (mf) - -	6.83×10 ⁻⁸	(m²) (m²)	987	. (uf)	Satellite Orbito Discharge Manometer Satellite Orbits	(2) 195 1957 8 1957 C(2	7α, 1957 β - -
270			6.83x10 ⁻⁸ 8.5x10 ⁻⁸	(m²) (m²)		- (m) - (m)	Satellite Orbito Discharge Manometer Satellite Orbits AUTITUI	(2) 1957 8 1957 C 2 	7α, 1957 β - - - - 280-290 D
270 275			6.83x10 ⁻⁸ 8.5x10 ⁻⁸	(m²) (m²)			Satellite Orbito Discharge Manometer Satellite Orbita AUTITUI Satellite-Orbits	(2) 1957 8 1957 C 2 	280-290 ID

STRUCTURE DATA Through Early 1960

Project ARIES — Contract Nonr 3071(00)

Number	Place Fired	Date	Time	Zone	Reference Data	Notes	Altitu Range,
60 Da.							300
57 p	•	-	•	•	Mikhnevich	(mf) - not found	
•	-	•	•	-	Mikhnevich	Entries marked with	(2) g data
			*****			for satellites at carrier rockets.	×4.
			-				
							280
O Km.							
57 β	•	-	-	-	Mikhnevich		
•	-	•	-	•	Mikhnevich		
	***************************************		•		هرواب البرسال ۱۴۰		200
	من داده است	-	-				
							į
O Km.							
57 β		_					
-	-	_	•	-	Mikhnevich		190
-	•	•	•	-	Mikhnevich		
				_	S ohilling		
							100
							100
) Km.							
							i
B	-	•	-	-	Mikhnevich		
•	•	•	•	•	Mikhnevich		
							50
Tanah di Salah di Sa			***************************************			-2 3-	į

UPPER ATMOSPHERE STRU(Measurements Reported Thros

	Altitude	Pressure		Density		Tempe	rature			•
	Km.	mm.Hg.	•.%	g/m³	•.%	°K	•, °K	Instrumentation	Vehicle	Numbe
-								ALTITU	DE RANGE 290	-500 Em.
	290	•		7.68x10 ⁻⁸	•	•	-	Satellite Orbite	(2) 1957α,	1957 β
	290	1.62x10 ⁻⁷	(mf)	4.36x10 ⁻⁸	(nf)	1026	(m)	Discharge Manometer	1957 8	-
L							_			
I				-						
ĺ										
•								ALTITU	RANGE 500	-310 Km.
1	300			·6.27x10 ⁻⁸	•	-	•	Satellite Orbita	(2) 1957a,	1957 B
I	300	1.57210-7	(nf)	3.53x10 ⁻⁸	(nf)	1048	(nf)	Discharge Manometer		-
_										
ı										ĺ



OSPHERE STRUCTURE DATA is Reported Through Early 1960

Project ARIES — Contract Nonr 3071(00)

Vehicle	Number	Place Fired	Date	Time	Zone	Reference Duta	Notes	Ältitud Rango, —— 300	Kr
TUDE RANGE 290	0-300 Km.								
(2) 1957a,	1957 β	•	•	-	•	Mikhnevich	(nf)- not found Entries marked with (9)	L
er 1957 &	•	_	•	•	•	Mikhnevich	are based on drag d for satellives and	ata	
				-			carrier rockets.		Γ
		· · · · · · · · · · · · · · · · · · ·				***********			r
								250	-
									┝
TUDE RANGE 300	0-310 Km.								┝
(2) 1957a,	1957 B	-	•	-	-	Mikhmevich			-
ur 1957 6	-	•	•	•	•	Mikhnevich			┝
								200	L
	-				-	····			L
									L



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UPPER ATMOSPHERE Measurements Reporte

	Altitude						
I -	Km.		ion/Component		Instrumentation	Vehicle	Number
•			lative to N				i
T		Be	Ле	A			!
3	57.4	0.998	1.005	1.001	Sampling .	Aerobee	8C-21
	59. 7	1.035	1.008	0.996	*	•	*
•.	62.5	1.155	1.00	0.962	•	∆-5	59
	65.6	1.44	1.08	0.93	•	Aerobee	8C-17
•	68.3	2.02	1.18	0.89	•	•	H
	62. 6			0.00	н		
• .	69.8	1.570	1.232	0.90		V- 2	59
	70.6	2.41	1.20	0.85	# 	Aerobee	80-17
••	85.5	3.1A	1.34	•	H	M	8C-34
ĺ.	83.4	2.943	1. <i>3</i> 95	0.82	H	V- 2	59
•							
1							:
•		Separation	n Ratios		Radio frequency		·
	120	0.98			Mass Spectrometer	Merubee-hi	NN3.198
•	120	0.42			*	•	MN3.17
1	130	0.60			61	H	MN3.19F
r	130	0.45			Ħ	•	MN3.18F
i.	130	0.30			#	H	MN3.17
1.	_						
1.	140	0.40			•	*	MN3.19#
ı	140	0.30			*	*	MN3.188
ĺ	140	0.50			H	•	MN3.17
(150	0.30			н	**	1073.19 5
l	150	0.20			#	H	MN3.18F
1	150	0.20				H	NN3.17
1			í		ì.		
1.	160	0.30		7		•	MN3.19F

PER ATMOSPHERE COMPOSITION DATA surrements Reported Through Early 1960

Vehicle	Number	Place Fired	Date	Time	Zone	Reference Data	Remarks
Velopee	8 0-21	HBPG	26 Se p '51	-	•	Jones 54	
	*	•	H	-	•	11	
¥-2	59	n	20 May 152	-	•	M	Recovered sample bottles
Aerobee	80-17	*	19 Dec '50	-	•	*	were analyzed in laboratory for amount of Helium, Heon,
*	•		•	-	•	•	and Argon relative to Hitrogen. These results were compared
A- 5	59	#	00 15 150			*	with the relative concentration of the games at sea level.
Aerobee	8C-17	H	20 May 152	-	-	" #	
il varopee	80-14 80-34	 H	19 Dec '50	~	Man	Wenzel 58	
V-2	59	H	9 Aug '56 20 May '52	08.53	Met	Jones 24	
V-2	29		20 May -72		•	Jones 74	
Aerobee-hi	NN3.19F	Church111	23 Mar 158	12.07	CST	Needown 60	
*	MM3.17	Ħ	20 Nov '56	23.21	•	•	
**	NN3.19F	**	23 Mar 158	12.07	**	•	Separation Ratio based on:
*	MN3.188	•	21 Feb 158	20.02	*	•	argon/molecular Mitrogen at altitude
•	MN3.17	**	20 Nov 156	23.21	*	•	Argon/molecular Nitrogen at see level
	NN3.198	**	23 Mar '58	12.07		н	
•	MN3.18#	*	21 Feb '58	20.02		*	
*	MM3.17	•	20 Nov '56	25.21			
•	NN3.19F		25 Mar '58	12.07		"	
	MN3.18F		21 Feb '58	20.02			
	,		2 65 70	EA!AE			i C M
H	HH3.17	**	20 Nov '56	23.21	41	*	
•	MN3.198	•	25 Mar '58	12.07		#	

Science Communication

Washington, D. C.

UPPER ATMOSPHERI Measurements Report

	Altitude						
	Km.	Composi	ion/Comp	onent	Instrumentation	Vehicle	Number
		Mean M MM3.17	lecular W	ight NN5.19			
	135	28.2	28.2	28.6	Mass Spectrometer	Aerobee-hi	MM3-17
	140	27.9	28.1	28.6	Mass Spectrometer	Aerobee-ld	mn5.18
. 1	150	27.8	•	28.2	Mass Spectrometer	Aerobee-hi	HH3 .19
1	160	27.8	-	•			
	170	27.8	27.5	27.5			
	180	•	27.5	27.5			i
	190	•	27.5	27.2			
1	200	•	26.7	-			ا
	210	-	26.8	-			1
I	550	•	25.8	•			
†							



PER ATMOSPHERE COMPOSITION DATA assurements Reported Through Early 1960

Project ARIES — Contract Nonr 3071(00)

Vehiclo	Number	Place Fired	Date	Time	Zone	Reference Data	Remarks
Aerobee-hi	MM3.17	Churchill	20 Nov 156	23.21	CST	Meadows 60	Inte from curve.
Aerobee-hi	BN3.18	Church111	21 7eb '58	20.02	CST	Mendove 60	See reference, figure 7.
Aerobee-hi	NN3.19	Churchill	25 Mar '58	12.07	CST	Needowe 60	



UPPER ATMOSPHERE Measurements Reporte

_	Altitude				
	Km.	Composition/Component Osone, Molecules/oc	Instrumentation	Vehicle	Number
Į.	30	5.0x10 ¹²	U. V. Spectrograph	-	•
4.	40	5.0x10 ¹¹	H	-	•
1	50	8.0x10 ¹⁰	*	•	•
•	60	9.0 ± 10 ⁹	•	•	•
1	70	9.0x10 ⁸		-	•
ı					
(\$ Mascriation of Q			
}		_	Photon Counters	Aerobee	A =25
;	120	67	M COUNTER	Vetabes	A-35
1	130	6	,		
i.	160	70	•	•	•
1					
1.		- 4			
<u>[</u>		Oxygen Molecules/oc			
4.	110	16.0x10 ¹⁰	Photon Counter	Aerobee	A-16
ľ.	114	12.0x10 ¹⁰	•	*	A-34
1.	116	9.0x10 ¹⁰	*	#	•
[118	2.3x1010	Ħ	•	Ħ
	120	1.8x10	•	*	*
	120	3.0x10 ¹⁰	*	•	A-1 6
1	130	1.0x10 ¹⁰	и		*
	150	4.0x10 ⁹	Ħ	*	A-35
1	=	1.4x10 ⁹	*	#	"
					н
	170	8.0x10 ⁸	**		,,
	180	4.0x10 ⁸	н	*	Ħ

PHERE COMPOSITION DATA toported Through Early 1960

Project ARIES — Contract Nonr 3071(00)

	Place	_		_		
Number	Fired	Date	Time	Zone	Reference Data	Remarks
-	WBPG	14 Jun '49	7.93	HET	Johnson 54	
-	•	W	#	•	•	
-	*	•	*		•	
-	•	•	*	*	*	!
-		•	Ħ	#	•	; ;
A-35	•	21 Oct '55	17.15	•	Byron 57	Dissoriation based on density
*			*	•	•	of molecular Oxygen measured by ultraviolet absorption relative
**	•		p	-	•	to density of Air at altitude,
						ļ
A-1 6	•	1 Dec '55	08.29	-	Byran 57	
A-34	-	18 Oct '55	15.50	•	•	
*	•		•	•		!
*	-			-	•	
*	-	•		-	•	Based on 44-60 A absorption of Molecular Orygon at altitude.
A-16	-	1 Dec '53	08.29	R +	H	
H	-	Ħ	•	•	•	
A-35	-	21 Oct 155	17.15	•	•	
H	-	n	*	-	n	2
**	-	•	H	•	H	

UPPER ATMOSPHERE Measurements Reporte

Altitude	Composition	- /C		Instrumentation	Trablata	Number
Em.	Ion Detecte	d Mass	<u> </u>	Instrumentation	Vehicle	Number
100	46"			Ion Spectrometer	Aerobee	MRL-24
110	•				•	
150	•			•	•	
150	*			H	•	•
						,
	Ion Detecte	d Maes				
100	28 ⁴			Ion Spectroreter	Aerobee	MRL-23
110	•			•	Ħ	•
115	•			•		•
	Mass Peaks					
115	30 ⁴ ;26 ⁴	32 ⁴	16 ⁺	Ion Spectrometer	Vi king	10
150	•	•	•	*	**	•
220	•			•	Ħ	Ħ
	Retio of Id		renta X ⁺ / ₍	+, Per Cent		
\$ 50-6 1	ю	9-E(p)		Mass Spectrometer	1958 ∝	•
250-21	70	#-S(w)		•	**	•



LTMOSPHERE COMPOSITION DATA ments Reported Through Early 1960

Project ARIES -- Contract Nonr 3071(00)

:lo	Number	Place Fired	Date	Time	Zone	Reference Data	Remarks
bee	MRL-24	MBFG #	29 Mov 157	10.16		Johnson 58	See paper for discussion of relative amplitudes of atomic mass units.
lee	NRL-23 "	MB.FG H	8 Jul '55 "	01. <i>5</i> 9 "	MST "	Johnson 58 H	N N
e.	10 "	MBLPG III	7 May 154 H	10.00 H	MET "	Johnson 55 H	
DC.	• •		22 May '58	-	•	Istomin	From curve of changing relative intensity. Ratios are also affected by latitude. (a) North latitudes (b) South latitudes



Properties of the Upper Atmosphere

APPENDIX A

Meteorological Instrumentation Employed for Pressure, Temperature, Density, and Composition Contract Nonr 3071(00) Final Report 1 August 1960

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App. A-1

THE DOVAP SYSTEM FOR ROCKET ALTITUDE MEASUREMENT

The DOVAP (Doppler Velocity And Position) system is used to determine the altitude and trajectory of research rockets. The system is represented schematically in Figure 1.

The ground transmitter radiates a signal on a reference frequency. This signal is received by both the tracking receivers and the rocket vehicle. A transponder in the rocket vehicle ret ansmits the reference signal at double the reference frequency. This signal is compared to the original reference signal also received at each of the tracking stations. The Doppler shift of the rocket's signal will be a function of the velocity of the rocket, and the altitude and azimuth of the incoming signal from the rocket determine the position of the transponder and its rocket vehicle.

The DOVAP system operates with an accuracy of all foot in position and l foot-second in velocity.

Literature Citation:

Massey, H.S.W., and R.L.F. Boyd, <u>The Upper Atmosphere</u>, pp. 66-70, Philosophical Library, New York, N. Y. 1959.

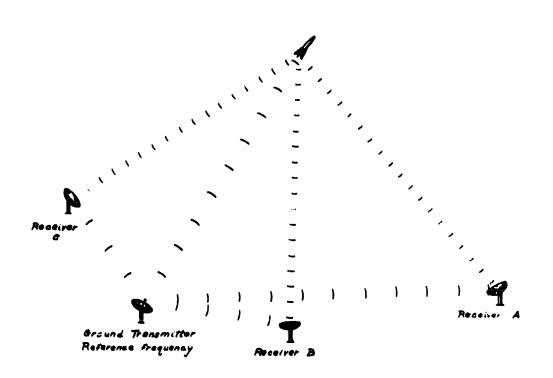


Figure 1

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(Alphatron)

Ionization gages measure the number of free ions produced by a flow of electrons in a diffuse gas. The relative numbers of free ions formed by a constant electron source is a function of the density and composition of the gas within the ionization gage.

The Alphatron is typical of the radioactive, cold-cathode type of ionization gage. A radioactive isotope within the gage provides a constant source of ionizing radiation. The instrument is essentially a modification of the electrostatic detectors used to count radioactive particles.

In the operating instrument (see Figure 2) a voltage is applied to both the wall and wire electrode of the gage. Gas atoms entering the page are ionized by the radioactive isotope, and the ionized gas atoms are then attracted to the wall of the gage. The drift of these ionized particles lowers the voltage between the two charged elements of the gage. When this voltage drops to a pre-set point, the chamber is redharged to its original voltage. The frequency of recharge is proportional to the rate of ion forwation.

The us- of ionization gages of the Alphatron type is based on the following assumptions:

The devices are insensitive to acceleration changes.

They provide rapid d'acrete responses to density changes of a homogenous medium.

By cuitably switching the voltage drops for recharging the instrument, it can be used to measure density directly to altitudes of about 200 kilometers.

Sources of error in the technique include:

The devices measure only the relative number of ions formed.

Ion formation is affected by the composition as well as the density of the gas being measured (see Figure 3).

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App. A-4

Ionization Gage (cont.)

External ion sources (e.g., the ions in the F and D layers of the upper atmosphere) will interfere with the ion counts obtained by the instrument.

Gas density is temperature dependent.

The instrument may not be at temperature equilibrium with the atmosphere. Density measurements are probably correct to within an order of magnitude up to 250 kilometers.

Literature Citations:

LaGow, H., "Arctic Atmosphere Structure to 250 Km," IGY Rocket Report Series, No. 1., pp. 38-46, 30 July 1958.

Non-N 60921-5608, Wright Instruments, Inc., "A Survey of Pressure and Density Sensors and Associated Problems for the N. O. L. HASP Program," April 1959.

Spencer, N. W. and W. G. Dow, "Density Gauge Methods for Measuring Upper-Air Temperature, Pressure, and Winds," Rocket Exploration of the Upper Atmosphere, pp. 82-97, Permagon Press Ltd., London, 1954.

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1 August 1960

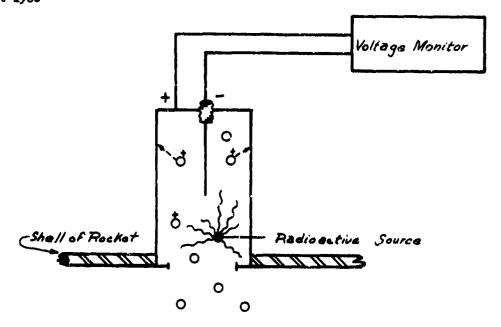


Figure 2

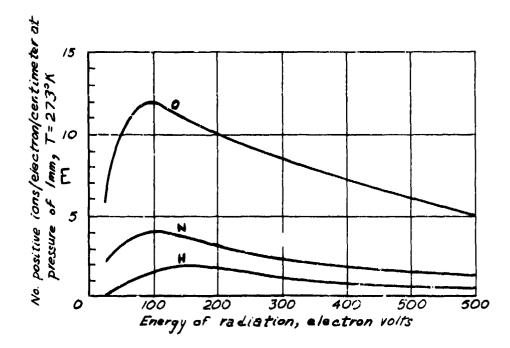


Figure 3

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THERMAL CONDUCTIVITY GAGES (Pirani Gage, Havens Gage)

Pirani Gage

Thermal conductivity, or Pirani gages, measure pressure by monitoring the resistance change of a heated wire element. Changes in air pressure surrounding the wire element change the rate at which heat is lost by the element. Pirani gages are commercially available which measure pressure down to 10⁻³ mm/Hg.

Havens Cage

The Haven's gage, developed at the Maval Research Laboratory, is a modification of the thermal conductivity gage. It measures pressures down to 10⁻⁵ mm/Hg.

The gage works on the principle that an alternating current signal can be obtained from the normally direct-current Pirani gage by cyclically changing the pressure at a given frequency. At low ambient pressures, the compression of the bellows does not affect the temperature of the gas within the bellows significantly. The cylical changes of the bellows will result in alternating voltage output from the resistance element, and the amplitude of the alternating voltage will be proportional to the change in ambient pressure. The eccentric shaft of the small motor, Figure 4, changes the volume of the bellows about 20 per cent at a frequency of about 20 cycles per second.

the same pressure in each bellow, regardless of the outside pressure. The outside pressure is communicated to the pressure chambers by small holes which restrict the rate of gas flow so that the gas does not flow completely out of the chamber when the bellows are compressed. Since the pressure inside the bellows chamber is changed about 40 times per second, the average pressure within the bellows will be st equilibrim with the outside pressure. The peak-to-peak alternating voltage developed across the resistance elements within the bellows will vary directly with the outside pressure. At a pressure of 0.6 mm/Hg, a change of

App. A-7

Thermal Conductivity Gages (cont.)

20 percent in the bellows pressure changes the voltage across the resistance by 0.27 volts. Figure 5 is a schematic of the calibration curve for a bellows gage in which the pressure is changing about 40 times per second.

Pressure measdurements by thermal conductivity gages are subject to error due to the variation of atmospheric composition, with the resulting variations of specific heat of the gas surrounding the heated wire.

Literature Citations:

Havens, R., R. Koll, and H. LaGow, "A New Vacuum Gauge," Rev. Sci. Instr., 21, 596-598 (1950).

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Washington, D. C. Project ARIES - Contract Numr 3071(00) Final Report 1 August 1960

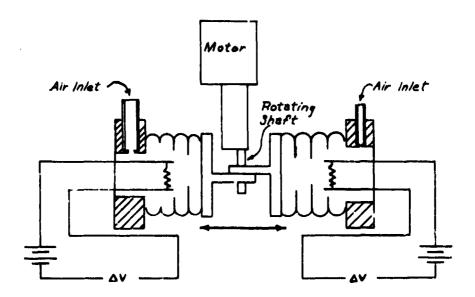


Figure 4

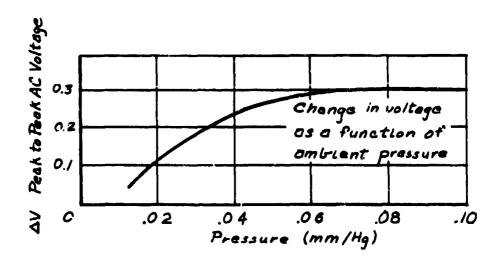


Figure 5

App. A-9

THE FALLING SPHERE

The technique of measuring the drag on a falling sphere, ejected from a rocket at peak altitude, to obtain upper air density and temperature was developed at the University of Michigan. The most recent form of the experiment uses a small sphere about seven inches in diameter.

Air density of the atmosphere is calculated from the velocity of the falling sphere using the drag equation:

e density

m = mass of sphere

an : drag acceleration

V z velocity of sphere

cross-sectional area of sphere

of sphere

C_D = coefficient of drag

Pressure and temperature at altitude are derived from the drag data by substitution in the hydrostatic equation:

$$T_{h} = \frac{\int_{P h g d h}^{h_{o}}}{P h g d h} + \frac{P_{o}}{P_{h}} T_{o}$$

T = temperature Okelvin

P = density

g s acceleration of gravity

gas constant

M molecular weight of air

An initial temperature is assumed for the beginning of the trajectory.

Early versions of the falling sphere experiment relied on Doppler radar tracking to derive the trajectory of the falling sphere. The more recent versions include an accelerometer and telemetering transmitter within the sphere to measure and transmit the drag acceleration from the sphere.

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The Falling Sphere (cont.)

The falling sphere experiment for determining atmospheric parameters is based on the following assumptions:

- 1. The hydrostatic barometric equation is valid for the region of the sphere trajectory.
- 2. The atmospheric composition is constant, and its mean molecular weight is fixed.

Possible errors for this method include:

- 1. The neglect of winds in the trajectory calculations.
- 2. The errors of measurement of the drag acceleration and the coefficient of drag for the sphere.
- 3. Possible errors in the calculation of the trajectory.

in addition, the assumed temperature at the begining of the trajectory introduces a possible error in the first 15 kilometers of the trajectory.

Literature Citation:

Bartman, F.L., "The Falling Sphere for Upper Air Density and Temperature," Rocket Exploration of the Upper Atmosphere, R.L.F. Boyd and M.J. Seaton, editors, Pergamon Press, Ltd., London, 1954.

Jones, L.M., "Upper-Air Density and Temperature: Some Variations and Abrupt Warming in the Mesosphere," J. Geophys. Res., 64, 2331-40 (1959).

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App. A-11

THE GRENADE EXPERIMENT,

The grenade experiment is based on measuring the average velocity of sound, traveling to the ground, when produced by a grenade exploded at various altitudes. The atmospheric temperature in the region of the grenade explosion is determined by the variation of sound velocity with the altitude of the grenade explosion. A schematic of the experiment is outlined in Figure 6.

The velocity of sound is calculated thus:

$$c = \sqrt{\frac{\gamma}{R}}$$
 T

 $\frac{\sqrt{R}}{M} = K \text{ (constant)}$

Thus: C = VKT

C s velocity of sound, dry air

√ = ratio of specific heats of air

R = gas constant

T = temperature Okelvin

M - molecular weight of air

The average temperature of the region between two grenade explosions is calcualted from the variation of the sound velocity from these explosions. Wind effects on the path of sound transmission are determined by a sound-ranging network which measures the directional position of the sound wave arriving on the ground. This direction yields the apparent position of the greuade explosion which is then compared with the true position, obtained by a DOVAP telemetering device.

The use of the grenade experiment for determining atmospheric temperature is based on the following assumptions:

- Vertical wind components are negligible compared with acoustic velocity in the region of measurement.
- 2. The composition of the atmosphere is constant up to about 90 kilometers, the region measured by the experiment.

App. A-12

The Grenade Exceriment (cont.)

The calculation for the experiment yield only the average temperature in the layer at which the grenade is detonated. This average temperature is assumed to exist throughout the layer.

Possible errors for the grenade experiment include:

- Variations with altitude of the specific heat or water vapor of the atmosphere introduce errors in the calculation of temperature, from the above equation.
- 2. The accuracy of the measurements is limited by the sound-ranging network's accuracy to determine the time of arrival of the sound waves at the individual microphones.
- 3. The grenade experiment is probably accurate to about 50 for determination of temperature to an altitude of about 90 kilometers.

 Above about 95 kilometers, sound waves cannot be generated with sufficient energy to reach ground stations.

Literature Citations:

Stroud, W.G., W.R. Bandeen, W. Nordberg, F.L. Bartman, J. Otterman, and P. Titus, "Temperature and Winds in the Arctic Obtained by the Rocket Grenade Experiment," IGY Rocket Report Series. 1, pp. 58-79, July 1958.

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App. A-13

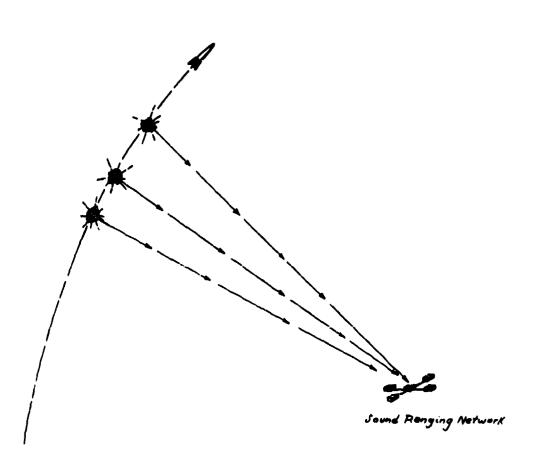


Figure 6

THE STREET

App. A-14

THE COMPOSITION-MASS SPECTROMETER

The Bennet radio-frequency mass spectrometer can be used to obtain spectra of atmospheric composition above 100 kilometers. A diagram of the device is shown in Figure 7. Ions are formed by the bombardment of air molecules with 45-volt electrons in the ion cage. These ions, drawn out and collimated by grids at points 3 and 4, are accelerated by a negative sweep potential into the analyzer section. This negative sweep potential is modified by a small constant-bias voltage applied to grids at points 5 and 7. Ions not receiving the maximum incremental energy per state in the analyzer are turned back by a positive stopping potential applied to grid at point 8. The desired ions have sufficient energy to overcome this positive potential and reach the collector.

The mass of the ions arriving in the collecting assembly can be represented as follows:

$$M = \frac{0.266 \text{ V}}{10.266 \text{ V}}$$

M = mass in atomic mass units

s = spacing between grids of anlyzersection in centimeters.

f s frequency in megacyles

V = voltage

Variation of either frequency or voltage will sweep the tube over a range of atomic mass units. The sweep rate is limited to the frequency response of the telemetering system in use. With a radio-frequency of 3.9 magacyles and a sweep varying between -250 and -25 volts, the instrument will cover the range between 48 and 5 atomic mass units.

Literature Citation:

Townsend, J.W., JR., Radiofrequency Mass Spectrometer for Upper Air Research, Naval Research Lucoratory, Washington 20, D.C., 8 January 1952.

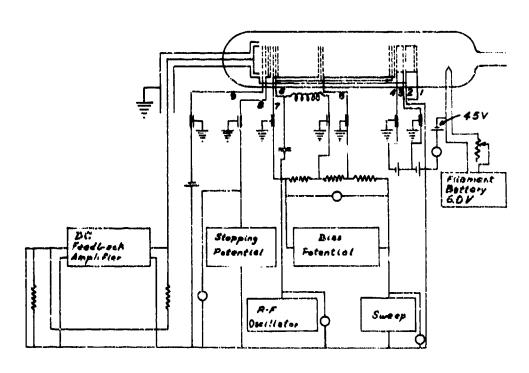


Figure 7

Properties of the Upper Atmosphere

APPENDIX B

Abstract Bibliography of Data Sources

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Upper Atmosphere Structure Data

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Bandeen

Bandsen, W.R., Griffith, R.M., Nordberg, W., Stroud, W.G., <u>The Measurement of Temperatures</u>, <u>Densities</u>, <u>Pressures and Wins over Fort Churchill, Canada, by means of The Rocket Grenade Experiment</u>, USASRDL Technical Report, 2076, U. S. Army Signal Research and Development Laboratory, Fort Monmouth, New Jersey, 1959.

Reports results of ten successful Aerobee firings at Fort Churchill.

Boggess 59

Boggess, R.L., Brace, L.H., Spencer, N.W., "Langmuir Probe Measurements in the Ionosphere, " J. Geophys. Res., 64, 1627 (1959).

Letter report of design of a Langmuir probe which is ejected from rocket at peak altitude. Preliminary electron temperature from 1 rocket flight are presented

Havens 52

Havens, R.R., Koll, R., LaGow, H.E., "Pressure, Density, and Temperature of the Earth's Atmosphere," J. Geophys. Res., 57, 59-72 (1952).

Describes instrumentation for density measurements and presents data from $3\ V-2$, Viking flights.

Horowitz 57

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i.

Horowitz, R., LaGow, H.E., "Upper Air Pressure and Density Measurements from 90-220 Kilometers with Viking 7 Rocket," J. Geophys. Res., 62, 57-77 (1957)

Presents pressure and density data from a 1951 Viking flight, the highest altitude from which structure data have been obtained by rockets.

Horowitz 58

Horowitz, R., IaGow, H.E., "Upper Air Pressure and Density Measurements from 90-220 Kilometers with Viking 7 Rocket," J. Geophys. Res., 62, 57-77 (1957).

Pressure, temperature, and density data from an Aerobee flight at Ft. Churchill are compared with that obtained by the Viking 7 at White Sands.

Jones 58

Jones, L.M., Fischbach, F.F., Peterson, J.W., "Seasonal and Latitude Variations in Upper Air Density," <u>IGY Rocket Report Series</u>, <u>1</u>, pp. 47-58, 1958.

Fresents results of air density and temperature determination by falling sphere technique for 6 Nike-Cajun, 1 DAN, and 6 Aerobee rocket flights to July 1958.

Jones 59

Jones, L.M., Peterson, J.W., Schaeffer, E.J., Schulte, H.F., "Upper Air Densities and Temperature: Some Variations and an Abrupt Warming in the Mesosphere," <u>J. Geophys.</u> Res., <u>64</u>, 2331-40 (1959).

Presents temperature and density data obtained in 8 Nike-Cajun rocket flights.

Washington, D. C.

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Upper Atmosphere Structure Data (cont.)

LaGow 54

Ladow, H.E., "Physical Properties of the Atmosphere into the F₁-Layer," <u>Rocket Explorations of the Upper Atmosphere</u>, R.L.F. Boyd and M. Seaton, editors, pp. 73-81, Pergamon Press, Ltd., London, 1954.

Review of results from early NRL V-2, Viking Program at White Sands. Presents pressure, temperature, and density data obtained from 13 rocket flights.

Meadows 60

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Presents density data from 3 Aerobee-Hi flights based on mass spectrometer determinations.

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Presents density, pressure, and temperature data to 500 kilometers obtained by instrumentation in the Soviet satellite launched 15 May 1958, 1958 6. Also presents density data to 720 kilometers based on analysis of drag from orbits of Soviet satellites and carrier rickets launched 4 Oct. 1957 and 3 Nov. 1957.

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Summary of density values to 400 Kilometers inferred from satellite observations and drag calculations.

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Sicinski, H.S., Spencer, N.W., Dow, W.G., "Rocket Measurements of the Upper Atmosphere. Ambient Temperature and Pressure in the 30-75 km. Region," <u>J. Appl. Phys.</u>, 25, 161-163 (1954).

Describes method for determination of ambient pressures and temperature based on ratio of pressure at nose come tip to nose come wall. Pressure and temperature data from 2 flights are presented.

Washington, D. C.

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Describes ionization gage instrumentation for determination of temperature, pressure, and density. Data from 3 V-2 and 1 Aerobee rocket flights are presented.

Spencer 58-1

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Review of experiments conducted by Dept. Electrical Engineering at University of Michigan in development of pressure sensing instrumentation. Presents results from preliminary data reduction from 2 Aerobee and 2 Nike-Cajum rocket flights.

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Spencer, N.W., Assearch in the Measurement of Ambient Pressure. Temperature, and Density of the Upper Atmosphere by means of Rockets, Final Report, Engineering Research Institute Project 2096, University of Michigan, June 1958.

Summary of research activities on radioactive ionization gage pressure measurement systems containing final report of "Air Force T-Day" experiment, and revised temperature data for Aerobee rocket flight.

Sterne 58

Sterne, T.E., Schilling, G.F., "Some Preliminary Values of Upper Atmosphere Density from Observations of USSR Satellites," <u>Smithsonian Contrib. Astrophys.</u>, 2, 207-211 (1958).

Density values at altitude of 220-233 kilometers based on orbital data of 1957 \bowtie 1, \bowtie 2, and β 1.

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Stroud, W.G., Nordberg, V., Walsh, J.R., "Atmosphere Temperatures and Winds between 30 and 80 km.," <u>J. Geophys. Res.</u>, <u>61</u>, 45 (1956).

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Presents results of grenade experiments in 10 Aerobee rocket flights at Ft. Churchill between 1956 and 1958.

Weisner 54

Weisner, A.G., "The Determination of Temperatures and Winds Above 30 Km.," Rocket Exploration of the Upper Atmosphere, R.L.F. Boyd and M. Seaton, editors, pp. 133-142, Pergamon Press, Ltd., London, 1954.

Describes the instrumentation for grenade experiment and presents some data obtained from 6 Aerobee flights at White Sands.

App. B-5

Upper Atmosphere Composition Data Bibliography

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Presents composition data on molecular oxygen concentration for 3 Aerobee flights to an altitude of 180 kilometers.

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Havens, R.R., Koll, R., LaGow, H.E., "Pressure, Density, and Temperature of the Earth's Atmosphere," J. Geophys. Res., 57, 59-72 (1952).

Describes instrumentation for density measurements and presents data from 3 V-2, Viking flights.

Horowitz 57

Horowitz, R., LaGow, H.E., "Upper Air Pressure and Density Measurements from 90-220 Km. with Viking 7 Rocket," J. Geophys. Res., 62, 57-77 (1957).

Presents pressure and density data from 2 1951 Viking flights. The highest altitude from which structure data have been obtained by rockets.

Horowitz 58

Horowitz, R., LaGow, H.E., "Summer Day Auroral-Zone Atmospheric Structure Measurements from 100-210 Km.," J. Geophys. Res., 63, 757-773 (1958).

Pressure, temperature and density data from an Aerobee flight at Ft. Churchill are compared with that obtained by the Viking 7 at White Sands.

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Istomin, V.G., "Some Results of the Measurements of the Spectrum Mass of Positive Ions by the 3rd Artificial Satellite," (Translated from Russian) NASA TECHNICAL TRANSLATION F-7, April 1960.

Presents radio frequency mass spectrometer data obtained from 225-980 kilometers. The composition data are strongly influenced by latitude of the orbiting satellite.

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Paper summarizes and discusses data obtained by solar spectroscopy on vertical distribution of Ozone. Presents Ozone composition data to an altitude of 70 kilometers obtained by a NRL rocket.

Washington, D. C.

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Upper Atmosphere Composition Data Bibliography (cont.)

Jones 54

Jones, L.M., "The Measurement of Diffuse Separation in the Upper Atmosphere," Rocket Exploration of the Upper Atmosphere, R.L.F. Boyd and M. Seaton, editors, pp. 143-157, Pergamon Press, Ltd., London, 1954.

Describes devices for collecting samples from upper atmosphere. Samples, returned in steel bottles, were analyzed in laboratories for Eelium, Meon, Argon, and Nitrogen. Data from 7 Aerobee and 5 V-2 flights are presented.

Meadows 60

Meadows, E.B., Townsend, J.W., "IGY Rocket Measurements of Arctic Atmospheric Composition Above 100 Km.," Paper presented at GOSPAR meeting in Nice, France, to be published in: <u>Proceedings of the Symposium of the Committee of Space Science (COSPAR)</u>, North-Holland Publishing Co., Amsterdam, Late Summer, 1960 (Western Representative Interscience Publishers, New York).

Presents composition data obtained on 4 Aerobee-Hi rocket flights instrumented with radio-frequency mass spectrometers. Instrumentation techniques and possible errors are discussed.

Wenzel 58

Wenzel, E.A., Loh, L.T., Nichols, M.H., Jones, L.M., "Diffusive Separation in the Upper Atmosphere," <u>IGY Rocket Report Series</u>, 1, pp. 91-107, 1958.

Reviews results of upper atmosphere sampling program. Composition data from 2 Aerobee flights are presented.

Science Communication Washington, D. C.

Properties of the Upper Atmosphere

APPENDIX C

Abstract Bibliography of Books, Review Articles, and Bibliographies

on the Upper Atmosphere

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Contract Nonr 3071(00) Final Report 1 August 1960

Abstract Bibliography of Books, Review Articles, and Bibliographies on the Upper Atmosphere

The publications listed below are recommended as background references in the field of upper atmosphere research.

Benson, O.O., Strughold, H., editors, Physics and Medicine of the Atmosphere and Space, John Wiley & Sons, Inc., New York, 1960.

Papers presented at 2nd International Symposium on Physics and Medicine of the Atmosphere and Space. Several review articles on upper atmosphere, but most of the papers are directed to problems of space flight.

Benton, M., editor, The Use of High-Altitude Rockets for Scientific Investigations, An Annotated Bibliography, U. S. Naval Research Laboratory, Washington, D. C., Bibliography No, 16, Oct. 1959.

This is an extensive bibliography of publications in the field of upper atmosphere research. Foreign as well as U. S. publications are included from 1946 to June 1959.

Boyd, R.L.F., Seaton, M.J., editors, <u>Rocket Exploration of the Upper Atmosphere</u>, Pergamon Press, Ltd., London, 1954.

Report of 1st major international conference concerned with rocket exploration of the upper atmosphere. The papers present a summary of experimental data to 1954.

Hanessian, J., Guttmacher, I., editors, <u>IGY Rocket Report Series</u>, <u>1</u>, Experimental Results of the U.S. Rocket Program for the International Geophysical Year to 1 July 1958, National Academy of Sciences, Washington, D. C., July 1958.

This compilation of research papers presents the results obtained during the first 12 months of the U.S. IGY program. The bulk of these papers were presented at the CSAGI Assembly held in Moscow in the summer of 1958.

Kniper, G.P., editor, The Earth as a Planet, University of Chicago Press, Chicago, 1954.

This book contains several lengthly review articles on the structure and composition of the atmosphere.

Massey, H.S.W., Boyd, R.L.F., editors, <u>The Upper Atmosphere</u>, Philosophical Library, New York, 1959.

A general discussion of upper atmosphere phenomena studied during IGY; few experimental data, but good generalized summaries.

App. (App. C-2

Abstract Bibliography of Books, Review Article, (cont.)

Newell, H.E., editor, Sounding Rockets, McGraw-Hill, New York, 1959.

This book presents performance characteristics of the principal atmospheric research rockets developed since the end of World War II.

Proceedings of the Symposium of the Committee of Space Sciences (COSPAR), so be published by North-Holland Publishing Co., Amsterdam, Late Summer 1960 (er 1960 (Western Representative Interscience Publishers, New York).

This book, to be published in the late summer of 1960, contains the tains the per presented at the First International Space Science Symposium held in Niced in Niced, France, Jan. 1960. The papers include the results obtained by the upper atmospher atmospher research programs of most of the countries participating in the IGY program.

Wright Instruments, Inc., Vestal, New York, <u>A Survey of Pressure & Densit & Density</u> Sensors & Associated Problems for The NOL Hasp Program, Final Report, April 1959.

A survey of "state of the art" in development of miniature pressure and density sensors.

Zelikoff, M., editor, The Threshold of Space, Pergamon Press, Ltd., New Yd., New Yo k, 1957.

Proceedings of Conference on Chemical Aeronomy at Cambridge, Mass. in Rune 1956, sponsored by the Geophysics Research Directorate of the Air Force, r Force, c mbridge Research Center. This bank contains papers by most of the active research research in the fields of atmospheric composition and photochemistry.

Defense Threat Reduction Agency

45045 Aviation Drive Dulles, VA 20166-7517

CPWC/TRC

May 6, 1999

MEMORANDUM FOR DEFENSE TECHNICAL INFORMATION CENTER ATTN: OCQ/MR WILLIAM BUSH

SUBJECT: DOCUMENT REVIEW

The Defense Threat Reduction Agency's Security Office has reviewed and declassified or assigned a new -AFSWP-1069, AD-341090, STATEMENT A Waiting, ply
-DASA-1151, AD-227900 CTTTTdistribution statement:

- -DASA-1355-1, **AD-336443**, STATEMENT AOK
- DASA-1298, AD-285252, STATEMENT A
- DASA-1290, AD-444208, STATEMENT A.
- DASA-1271, AD-276892, STATEMENT A
- DASA-1279, AD-281597, STATEMENT A
- DASA-1237, AD-272653, STATEMENT AV
- DASA-1246, AD-279670, STATEMENT A
- DASA-1245, AD-419911, STATEMENT A >
- _ DASA-1242, AD-279671, STATEMENT A
- DASA-1256, AD-280809, STATEMENT A
- --- DASA-1221, AD-243886; STATEMENT A
 - DASA-1390, AD-340311, STATEMENT A
 - DASA-1283, AD-717097, STATEMENT A OK
 - -- DASA-1285-5, AD-443589, STATEMENT A
 - DASA-1714, AD-473132, STATEMENT A
 - -- DASA-2214, AD-854912, STATEMENT A
 - -- DASA-2627, AD-514934, STATEMENT A 🗸
 - -- DASA-2651, AD-514615, STATEMENT A /
 - DASA-2536, AD-876697, STATEMENT A
 - -DASA-2722T-V3, AD-518506, STATEMENT A 🗸
 - DNA-3042F, AD-525631, STATEMENT A 🗸
 - 'DNA-2821Z-1, AD-522555, STATEMENT A

If you have any questions, please call me at 703-325-1034.

Andith Jarrett ardith Jarrett

Chief, Technical Resource Center